Napomene

Uvod

Definisao ju je i popularizovao (Uexküll, 1909)
Ikskil je uporedio telo životinje Savremeni prevod Ikskilovog uticajnog dela – Uexküll (2010).
„Svaka kuća ima više prozora“ (Uexküll, 2010, p. 200)
„One se kreću kao kompletna, potpuna stvorenja“ (Beston, 2003, p. 25)
Da bi stekle utisak o okruženju Klasično delo o osnovama biologije čula – Dusenbery (1992).
Neuronaučnik Malkolm Makajver smatra (Mugan and MacIver, 2019)
Životinje moraju stalno da drže čulne sisteme (Niven and Laughlin, 2008; Moran, Softley, and Warrant, 2015)
Godine 1987, nemački naučnik Ridiger Vener (Wehner, 1987)
„svedeno i pretvoreno“ (Uexküll, 2010, p. 51)
Džinovski kitovi imaju (Pyenson et al., 2012)
Postaknut tim razgovorom (Johnsen, 2017)
Međutim, prema filozofkinji Fioni Makferson (Macpherson, 2011)

„čula ne mogu podeliti“ (Macpherson, 2011, p. 36)
„nema razloga pretpostavljati“ (Nagel, 19 , pp. 438–439)
Zoolog Donald Grifin (Griffin, 19)
„moć imaginacije potkrepljena pouzdanim činjenicama“ (Horowitz, 2010, p. 243)
„Jedino pravo putovanje“ (Proust, 1993, p. 343)

1. POGLAVLJE
Vrećice koje ispuštaju hemikalije
Mirisi i ukusi

Horovic je stručnjak Za više informacija o psima i njihovom čulu mirisa, toplo preporučujem dve knjige Aleksandre Horovic (2010, 2016).
Takva lica se danas lakše (Kaminski et al., 2019)
Međutim, kad pas njuši (Craven, Paterson, and Settles, 2010)
Takav isti osnovni mehanizam imaju i ljudi (Quignon et al., 2012)
Oblik njihovih nozdrva (Craven, Paterson, and Settles, 2010)
Tokom jednog eksperimenta (Steen et al., 1996)
Naučnici su pokušali da utvrde (Krestel et al., 1984; Walker et al., 2006; Wackermannová, Pinc, and Jebavý, 2016)
U jednom istraživanju, dva psa (Krestel et al., 1984)
U nekim eksperimentima od ranije (Hepper, 1988)
Uspeli su da otkriju jedan otisak prsta (Hepper and Wells, 2005)
Uspeli su da otkriju kojim putem (King, Becker, and Markee, 1964)
Zavisno od vrste, žabe koje su izložene stresu (Smith et al., 2004)
Mogući izuzetak je zmija otrovnica afrički pafeder (Miller, Maritz, et al., 2015)
Kad je Horovic prikupila sva istraživanja (Horowitz and Franks, 2020)

ispred svake životinje (Duranton and Horowitz, 2019)
Nekima se ne sviđa to što se pseće čulo mirisa smatra (Pihlström et al., 2005)
U nekim slučajevima, ljudi su *uspešniji* (Laska, 2017)
Makgan je utvrdio (McGann, 2017)
Godine 2019, Tali Vajs je pronašla (Weiss et al., 2020)
„od izuzetno male koristi“ (Darwin, 18 , volume 1, p. 24)
„miris ne dozvoljava opisivanje“ (Kant, 2007, p. 2)
Engleski jezik potvrđuje taj stav (Majid, 2015)
„reči ne postoje“ (Ackerman, 1991, p. 6)
Narod Džahai iz Malezije (Majid et al., 2017; Majid and Kruspe, 2018)
Godine 2006, neuronaučnik Džes Porter (Porter et al., 2007)
Njihove signale zatim mogu da osete (Silpe and Bassler, 2019)
Hemikalije su najstariji (Dusenbery, 1992)
Razlike među odorantima Odličan članak o osnovama njuha je Keller and Vosshall (2004b).
Kad se neki parovi mirisa pomešaju, (Keller and Vosshall, 2004b)
Noam Sobel, neurobiolog (Ravia et al., 2020)
Njihovi nosevi su kraljevi beskonačnog prostora Članci o čulu mirisa: Eisthen (2002); Ache and Young (2005); Bargmann (2006).
Tokom istraživanja koje će im kasnije doneti Nobelovu (Firestein, 2005)
Jedna široko rasprostranjena teorija (Keller and Vosshall, 2004a)
Primera radi, gen OR7D4 (Keller et al., 2007)
Primera radi, mužjaci noćnog leptira (Vogt and Riddiford, 1981)
Miris im je toliko važan (Kalberer, Reisenman, and Hildebrand, 2010)
Za noćne leptire se govori (Atema, 2018)
Oponašajući mirise ženki noćnog leptira (Haynes et al., 2002)

Hemikalije koje oni koriste zovu se feromoni Članak o životinjskim feremonima – Wyatt (2015a).
Naime, bez obzira na feromonske žurke (Wyatt, 2015b)
Ljudski feromoni verovatno postoje (Wyatt, 2015b)
Mravlji feromoni su druga priča (Leonhardt et al., 2016)
Mravi listorezači su toliko osetljivi (Tumlinson et al., 19)
Poznati i kao kutikularni ugljovodonici (Sharma et al., 2015)
Kraljice takođe koriste te supstance (Monnin et al., 2002)
Crveni mravi će se brinuti (Lenoir et al., 2001)
Mravi legionari toliko dosledno (Schneirla, 1944)
Septembra 2020, naveo sam (Yong, 2020)
Mnogi mravi pomoću feromona prepoznaju uginule (Wilson, Durlach, and Roth, 1958)
„Svet mrava je komešanje“ (Treisman, 2010)
Civilizacije mrava spadaju među najčudesnije (D'Ettorre, 2016)
Mravi su u sušini grupa (Moreau et al., 2006)
Tokom tog procesa, repertoar njihovih gena za mirisne receptore (McKenzie and Kronauer, 2018)
Zašto? Evo tri razloga. (McKenzie and Kronauer, 2018)
Kad je Kronauer lišio svoje klonske mrave napadače (Trible et al., 2017)
Švajcarski naučnik Ogast Forel (Forel, 18)
Ženke rakova uriniraju u lice (Atema, 2018)
Mužjaci miševa izlučuju feromon (Roberts et al., 2010)
Paukoliki šarenbubac na prevaru navodi mužjake pčela (Schiestl et al., 2000)
„Mi sve vreme živimo“ (Wilson, 2015)
Ne morate da znate za rekordno veliki (Niimura, Matsui, and Touhara, 2014)
Afrički slonovi surlama mogu (McArthur et al., 2019)
Oni mogu da se upoznaju s mirisima koje još nisu sreli (Miller, Hensman, et al., 2015)
Dva od ta tri slona (von Dürckheim et al., 2018)

Ni azijski slonovi nisu nesposobnjakovići (Plotnik et al., 2019)
Kad bi se životinje približile opranoj odeći (Bates et al., 2007)
Kad se afrički slonovi ponovo nađu na okupu (Moss, 2000)
Malo je onih koji su proučavali mirise slonova (Hurst et al., 2008)
Godine 1996, posle petnaest godina rada (Rasmussen et al., 1996)
Rasmusen je na kraju otkrila da slonovi (Rasmussen and Schulte, 1998)
Dok hodaju stazama istrošenim od vremena (Hurst et al., 2008)
Godine 2007. Lusi Bejts je osmislila (Bates et al., 2008)
Slonovi koji su se vratili u Angolu posle rata (Miller, Hensman, et al., 2015)
Poznato je da su kopali bunare (Ramey et al., 2013)
Rasmusen je jednom prilikom iznela pretpostavku (Rasmussen and Krishnamurthy, 2000)
Losos može da se vrati (Wisby and Hasler, 1954)
Bič pauci (amblipigi) koriste senzore mirisa (Bingman et al., 2017)
Polarni medvedi mogli bi (Owen et al., 2015)
Takvi primeri su toliko česti (Jacobs, 2012)
Džon Džejms Odubon, strastveni prirodnjak (Stager, 1964; Birkhead, 2013; Eaton, 2014)
Te ptice, kako je konstatovao 1826 (Audubon, 1826)
Ornitolog Kenet Stejger (Stager, 1964)
U život ju je vratila Betsi Bang Istorijski osvrt na uticaj Bang i Venzel – Nevitt and Hagelin (2009).
Zabrinuta zbog toga što su udžbenici širili dezinformacije (Bang, 1960; Bang and Cobb, 1968)
Njima je „čulo mirisa najvažnije" (Nevitt and Hagelin, 2009)
Analizom lobanje tih životinja (Zelenitsky, Therrien, and Kobayashi, 2009)
Na jednom drugom mestu u Kaliforniji, Bernis Venzel (Sieck and Wenzel, 1969)

Ponovila je taj test (Wenzel and Sieck, 19)
I Bang i Venzel (Nevitt and Hagelin, 2009)
Različite količine hemikalije (Nevitt, 2000)
Kad je stala na noge, Nevit (Nevitt, Veit, and Kareiva, 1995)
Proračunala je da one mogu i da namirišu (Nevitt and Bonadonna, 2005)
Pokazala je da neke cevonoske (Bonadonna et al., 2006; Van Buskirk and Nevitt, 2008)
Anri Vejmerskirš je na lutajuće albatrose (Nevitt, Losekoot, and Weimerskirch, 2008)
Mirisni predeli za kojima tragaju morske ptice (Nevitt, 2008; Nevitt, Losekoot, and Weimerskirch, 2008)
Ona je prenela nekoliko golemih zovoja (Gagliardo et al., 2013)
„Ono što nama možda deluje bezlično" (Nicolson, 2018, p. 230)
Poredeći odorante (Sobel et al., 1999)
Šta god da je po sredi, ozbiljni naučnici (Schwenk, 1994)
Mužjak zmije podvezice jezikom može (Shine et al., 2003)
Poredeći ono što je ona usput ostavila (Ford and Low, 1984)
Švenk je zaključio da im račva (Schwenk, 1994)
Rulon Klark, koga ćemo upoznati (Clark, 2004; Clark and Ramirez, 2011)
Osim smrtonosnih toksina (Durso, 2013)
Zmije koriste te arome (Chiszar et al., 1983, 1999; Chiszar, Walters, and Smith, 2008)
Čak Smit, jedan od Švenkovih bivših studenata (Smith et al., 2009)
Čak Smit, jedan od Švenkovih bivših studenata (Ryerson, 2014)
Iz nekog razloga, ljudi su ga izgubili (Baxi, Dorries, and Eisthen, 2006)
Bez njega, zmije podvezice nisu sposobne da prate trag (Kardong and Berkhoudt, 1999)
Kod drugih životinja, taj organ nam je zagonetka (Baxi, Dorries, and Eisthen, 2006)

Odrasli se toliko razlikuju (Pain, 2001)
I iako miris može imati (Yarmolinsky, Zuker, and Ryba, 2009)
Kad piton proguta prase (Secor, 2008)
Pčele mogu da osete slatkoću (de Brito Sanchez et al., 2014)
Muve mogu da osete ukus jabuke (Thoma et al., 2016)
Parazitoidne ose mogu da upotrebe senzore za ukus (Van Lenteren et al., 2007)
Ali ako je na ruku isprskan gorki repelent (Dennis, Goldman, and Vosshall, 2019)
Neki imaju receptore za ukus na krilima (Raad et al., 2016)
Muve počinju da se čiste (Yanagawa, Guigue, and Marion-Poll, 2014)
Najopsežnije čulo ukusa (Atema, 19 ; Caprio et al., 1993)
Receptori za ukus nalaze im se (Kasumyan, 2019)
Izuzetno su osetljivi na aminokiseline (Caprio, 19)
Kad je Kaprio sredinom devedesetih godina (Caprio et al., 1993)
Mačke, pegave hijene (Jiang et al., 2012)
Vampirski slepi miševi, koji piju samo krv (Shan et al., 2018)
I ostali stručnjaci za ishranu lišćem, poput koala (Johnson et al., 2018)
Godine 2014, evoluciona biološkinja Mod Boldvin (Toda et al., 2021)
Boldvin je takođe pokazala da je kolibri (Baldwin et al., 2014)
Sve životinje vide na taj način (Nilsson, 2009)

2. POGLAVLJE
Bezbroj vrsta vida
Svetlost

Vrsta *Portia* čuvena je (Cross et al., 2020)
I, za razliku od ostalih paukova (Morehouse, 2020)
Pokojni britanski neurobiolog Majk Lend Lend je odlično opisivao svoj rad u Land (2018).

Godine 1968, on je napravio oftalmoskop (Land, 1969a, 1969b)
„uzbudljivo ali vrlo čudno“ (Land, 2018, p. 107)
A evo i zaista čudnog podatka (Jakob et al., 2018)
Gigantska lignja ima oči (Nilsson et al., 2012; Polilov, 2012)
Lignje, paukovi-skakači i ljudi A review of animal eyes is Nilsson (2009).
Oči životinja mogu biti bifokalne (Stowasser et al., 2010; Thomas, Robison, and Johnsen, 2017)
Mogu imati sočiva (Li et al., 2015)
Džejkobin kolega Nejt Morhaus (Goté et al., 2019)
vid „povezan sa svetlošću“ (Johnsen, 2012, p. 2)
Svaka životinja koja vidi (Porter et al., 2012)
Godine 2012, evoluciona biološkinja Megan Porter (Porter et al., 2012)
Čulo vida je raznoliko *Visual Ecology* je fantastičan i veoma zanimljiv udžbenik o osnovama vida i načinima njegove primene (Cronin et al., 2014)
Biolog Dan-Erik Nilson (Nilsson, 2009)
Hidri, rođaki meduze (Plachetzki, Fong, and Oakley, 2012)
Maslinaste morske zmije imaju fotoreceptore (Crowe-Riddell, Simões, et al., 2019)
Hobotnicama, sipama i ostalim glavonošcima (Kingston et al., 2015)
Japanski leptir *Papilio glaucus* (Arikawa, 2001)
Taj talas noviteta koje je donela evolucija (Parker, 2004)
„Pretpostavka da je oko“ (Darwin, 1958, p. 1)
Samo su meduze razvile (Picciani et al., 2018)
Godine 1994, Nilson i Suzan Pelger (Nilsson and Pelger, 1994)
Kao što smo videli u Uvodu (Garm and Nilsson, 2014)
Uzmimo za primer slatkovodnu bakteriju *Synechocystis* (Schuergers et al., 2016)
Porodica dinoflagelata, grupa jednoćelijskih algi (Gavelis et al., 2015)

Karo se kao poslednji (Caro, 2016)
Ona i Karo su procenili da (Melin et al., 2016)
Karo ima pouzdan odgovor: da odbije muve koje sisaju krv (Caro et al., 2019)
Oštrina vida životinje Odličan članak o oštrini vida životinja je Caves, Brandley, and Johnsen (2018).
Trenutni rekord od stotinu trideset osam ciklusa po stepenu (Reymond, 1985; Mitkus et al., 2018)
U često citiranoj studiji rađenoj sedamdesetih godina 20. veka (Fox, Lehmkuhle, and Westendorf, 19)
Biološkinja koja izučava čula Elenor Kejvs (Caves, Brandley, and Johnsen, 2018)
Hobotnice (ciklusa po stepenu) (Veilleux and Kirk, 2014; Caves, Brandley, and Johnsen, 2018)
Oštrina vida grabljive muve (Feller et al., 2021)
Da bi muva imala oštar vid (Kirschfeld, 19)
svake polovine lepezaste školjke (Mitkus et al., 2018)
Još je čudnije to što su te oči (Land, 1966)
obe grupe životinja imaju obe vrste receptora (Speiser and Johnsen, 2008a)
Vezao je školjke (Speiser and Johnsen, 2008b)
Godine 1964, Majk Lend (Land, 2018)
Kristali od guanina ne formiraju prirodno kvadratni oblik (Palmer et al., 2017)
Hitoni su mekušci (Li et al., 2015)
Morski crvi *Sabella spallanzanii* liče na (Bok, Capa, and Nilsson, 2016)
Džinovske školjke izgledaju kao (Land, 2003)
Godine 2018, Loren Samner-Runi (Sumner-Rooney et al., 2018)
Poput zmijača, morski jež (Ullrich-Luter et al., 2011)
Još je čudnije to što je ona oko (Sumner-Rooney et al., 2020)
Samo u jednoj španskoj pokrajini (Carrete et al., 2012)
Godine 2012, Martin i njegove kolege (Martin, Portugal, and Murn, 2012)

Lešinar koji pretražuje zemlju Videti Martin (2012), gde je takođe dat prikaz i navode se Martinovi brojni radovi o vidnom polju ptica.
„Čovekov vizuelni svet“ (Martin, 2012)
Mnogim životinjama na jednom mestu (Moore et al., 2017; Baden, Euler, and Berens, 2020)
Kad pile posmatra nešto (Stamp Dawkins, 2002)
Mnoge ptice grabljivice (Mitkus et al., 2018)
Kad se sivi soko (Potier et al., 2017)
Leva polovina pilećeg mozga Veliki broj eksperimenata je opisan u Rogers (2012).
Vidno polje foke (Hanke, Römer, and Dehnhardt, 2006)
Krave i ostala marva (Hughes, 19)
Isto važi i za Odličan članak o podeli mrežnjača životinja na zone je Baden, Euler, and Berens (2020).
Slonovi, nilski konji, nosorozi, kitovi (Mass and Supin, 1995; Baden, Euler, and Berens, 2020)
Kitove zenice se ne skupljaju (Mass and Supin, 2007)
Kameleoni ne moraju da se okreću (Katz et al., 2015)
Mnogi mužjaci muva usredsređeni su nagore (Perry and Desplan, 2016)
Oči ribe *Anableps anableps* (Owens et al., 2012)
Dolichopteryx longipes (Partridge et al., 2014)
Istu mogućnost ima lignja *Histioteuthis* (Thomas, Robison, and Johnsen, 2017)
U međuvremenu, ljuskar *Streetsia* (Meyer-Rochow, 19)
Ako uspete da namamite muvu grabljivicu (Simons, 2020)
Snimajući njihove juriše (Wardill et al., 2013)
Taj ultrabrzi lov usmerava (Gonzalez-Bellido, Wardill, and Juusola, 2011)
U poređenju s fotoreceptorima vinske mušice (Gonzalez-Bellido, Wardill, and Juusola, 2011)
S druge strane, fotoreceptorima (Masland, 2017)
Životinje u principu imaju višu kritičnu frekvenciju treperenja (Laughlin and Weckström, 1993)

U poređenju s ljudskim vidom Nekoliko vrednosti kritične frekvencije treperenja kod životinja može se naći u radu autora Healy et al. (2013); Inger et al. (2014).

Oči sabljarke (Fritsches, Brill, and Warrant, 2005)

Mnoge ptice imaju prirodno brz vid (Boström et al., 2016)

Obično fluorescentno svetlo treperi na 100 Hz (Evans et al., 2012)

Ti insekti imaju još brže oči (Ruck, 1958)

Snimajući je (Warrant et al., 2004)

Prvi je očigledan (O'Carroll and Warrant, 2017)

Drugi problem nije toliko intuitivan (O'Carroll and Warrant, 2017)

Potrebno je mnogo energije (Niven and Laughlin, 2008; Moran, Softley, and Warrant, 2015)

Druge u potpunosti otkazuju pretplatu na vid (Porter and Sumner-Rooney, 2018)

Oko može da odumre na mnogo načina (Porter and Sumner-Rooney, 2018)

Neke se služe trikovima s neuronima (Warrant, 2017)

Struktura irvasovog tapetuma (Stokkan et al., 2013)

Tarzijeri – mali primati (Collins, Hendrickson, and Kaas, 2005)

Zaranjajući u okean (Warrant and Locket, 2004)

Na deset metara dubine Dva odlična članka o vidu u okeanu – Warrant and Locket (2004); Johnsen (2014).

Da bi ukazala više poštovanja za umvelte dubokog mora (Widder, 2019)

Snimak je bilo potpuno jasan (Johnsen and Widder, 2019)

Međutim, nijedno drugo stvorenje (Nilsson et al., 2012)

Sonke Džonsen, Erik Varant i Dan-Erik Nilson (Nilsson et al., 2012)

Prvi video-snimak u prirodnom okruženju napravljen je 2012. (Schrope, 2013)

Međutim, 2002. godine Erik Varant (Kelber, Balkenius, and Warrant, 2002)

3. POGLAVLJE
Cubičasta, zubičasta, žubičasta
Boja

u jednom udžbeniku pisalo je (Tansley, 1965)

Ipak, vrlo malo vrsta (Neitz, Geist, and Jacobs, 1989)

Psi zaista vide u boji (Neitz, Geist, and Jacobs, 1989)

Svetlost dolazi do nas u određenom opsegu Odlične osnove o vidu u boji potražite u radu autora Osorio and Vorobyev (2008); Cuthill et al. (2017); i 7. poglavlje Cronin et al. (2014).

vodene buve *Daphnia* Članak o neobičnom vidu u boji – Marshall and Arikawa (2014).

Uzmimo za primer umetnika (Sacks and Wasserman, 1987)

Neki od njih, poput lenjivaca i armadilja (Emerling and Springer, 2015)

Drugi, među kojima su rakuni i ajkule (Peichl, 2005; Hart et al., 2011)

Kitovi takođe imaju samo jednu vrstu čepića (Peichl, Behrmann, and Kröger, 2001)

Glavonošci – hobotnice, lignje i sipe – začudo imaju (Hanke and Kelber, 2020)

Izuzetak je lignja svitac (Seidou et al., 1990)

Fiziolog Vadim Maksimov pretpostavio je (Maximov, 2000)

Psi imaju dve vrste čepića (Neitz, Geist, and Jacobs, 1989)

To znači da konji teško (Paul and Stevens, 2020)

Daltoniste mogu zbunjivati (Colour Blind Awareness, n.d.)

Prvi primati (Carvalho et al., 2017)

Upravo to se desilo (Carvalho et al., 2017)

Svaki dodatni opsin eksponencijalno uvećava (Pointer and Attridge, 1998; Neitz, Carroll, and Neitz, 2001)

Od devetnaestog veka (Mollon, 1989; Osorio and Vorobyev, 1996; Smith et al., 2003)

U skorije vreme, neki istraživači (Dominy and Lucas, 2001; Dominy, Svenning, and Li, 2003)
Godine 1984, Džerald Džejkobs (Jacobs, 1984)
Ti majmuni nikad nisu razvili (Jacobs and Neitz, 1987)
Izuzetak su drekavci (Saito et al., 2004)
Ženke mogu da naslede dve (Jacobs and Neitz, 1987)
Otkrila je da nijedna grupa (Fedigan et al., 2014)
Trihromati zaista uspešnije (Melin et al., 2007, 2017)
Godine 2007, Nicovi (Mancuso et al., 2009)
Osamdesetih godina devetnaestog veka, Džon Lubok (Lubbock, 1881)
Samo je uzan pojas talasnih dužina (Dusenbery, 1992)
U to vreme, neki naučnici Odličan prikaz ultraljubičastog vida i njegove prošlosti potražite u delu autora Cronin and Bok (2016).
Međutim, posle još pedeset godina (Goldsmith, 1980)
Opet pogrešno mišljenje: godine 19 (Jacobs, Neitz, and Deegan, 1991)
Nije tačno: u drugoj deceniji dvadeset prvog veka (Douglas and Jeffery, 2014)
To se desilo slikaru Klodu Moneu (Zimmer, 2012)
Većina životinja koje imaju vid u boji (Tedore and Nilsson, 2019)
Neki naučnici smatraju (Marshall, Carleton, and Cronin, 2015)
Irvasi brzo prepoznaju (Tyler et al., 2014)
Cveće koristi živopisne ultraljubičaste šare (Primack, 1982)
Paukovi krabe skrivaju se (Herberstein, Heiling, and Cheng, 2009)
Godine 1998, dva nezavisna tima (Andersson, Ornborg, and Andersson, 1998; Hunt et al., 1998)
Isto važi i za (Eaton, 2005)
Riba ksifo (Cummings, Rosenthal, and Ryan, 2003)
Međutim, Ulrike Sibek je otkrila (Siebeck et al., 2010)

Naučnici su joj često pripisivali (Stevens and Cuthill, 2007)
Godine 1995, tim finskih istraživača (Viitala et al., 1995)
Godine 2013, ona i njene kolege (Lind et al., 2013)
Iskorišćavajući prirodni instinkt kolibrija (Stoddard et al., 2020)
Zamislite ljudski trihromatski vid Članak koji opisuje vid u boji autora Kelber, Vorobyev, and Osorio (2003).
Stodard je otkrila da te nespektralne boje (Stoddard et al., 2020)
Mnoga navodno „bela" ptičja pera (Stoddard et al., 2019)
Reptili, insekti i slatkovodne ribe (Neumeyer, 1992)
Posmatrajući tetrahromate (Collin et al., 2009)
100 **Na jednoj lokaciji te dve vrste** (Hines et al., 2011)
100 **Međutim, 2010. godine, Brisko je otkrila** (Briscoe et al., 2010)
100 **Čak i ptice, koje imaju jedan ultraljubičasti opsin** (Finkbeiner et al., 2017)
100 **Godine 2016, student Adrijane Brisko** (McCulloch, Osorio, and Briscoe, 2016)
Negde u Njukaslu u Engleskoj (Jordan et al., 2010)
Otprilike jedna od osam žena (Greenwood, 2012; Jordan and Mollon, 2019)
Postoje najmanje tri vrste (Zimmermann et al., 2018)
Kentaro Arikava je otkrio (Koshitaka et al., 2008; Chen et al., 2016; Arikawa, 2017)
Palice velikog batinaša (Patek, Korff, and Caldwell, 2004)
Kad je Maršal pogledao tu traku (Marshall, 1988)
Na njihovo zaprepašćenje (Cronin and Marshall, 1989a, 1989b)
Središnja pruga se sastoji Odličan članak o vidu rakova bogomoljki – Cronin, Marshall, and Caldwell (2017).
Rakovi bogomoljke imaju više vrsta (Marshall and Oberwinkler, 1999; Bok et al., 2014)
The Oatmeal (Inman, 2013)

Godine 2014, Maršalova studentkinja (Thoen et al., 2014)
Najdželov pogled se neprekidno kreće (Daly et al., 2018)
Rakovi bogomoljke rade nešto slično (Marshall, Land, and Cronin, 2014).
Kad primeti nešto (Land et al., 1990)
Ljudi uglavnom nisu svesni (Marshall et al., 2019b)
Glavonošci su osetljiviji (Temple et al., 2012)
Istraživač na postdoktorskim studijama (Chiou et al., 2008)
Oni mogu i da rotiraju oči (Daly et al., 2016)
Jedna vrsta odbija tu svetlost (Gagnon et al., 2015)
Tom Kronin misli (Cronin, 2018)
Crveno lice (Hiramatsu et al., 2017; Moreira et al., 2019)
Međutim, same ribe (Marshall et al., 2019a)
Međutim, Moli Kamings (Maan and Cummings, 2012)
Godine 1992, Lars Čitka (Chittka and Menzel, 1992)
Njihova vrsta trihromatizma (Chittka, 1997)

4. POGLAVLJE
Neželjeno čulo
Bol

Toplo preporučujem naučni rad (Braude et al., 2021)
Golo slepo kuče je toliko čudna životinja (Park, Lewin, and Buffenstein, 2010; Braude et al., 2021)
Predmete hvataju tako što razdvajaju (Catania and Remple, 2002)
Spermatozoidi su im nepravilnog oblika (Van der Horst et al., 2011)
Mogu da prežive i do (Park et al., 2017)
Takođe su bili primorani (Zions et al., 2020)
Park je to pokazao pomoću komore (Park et al., 2017)
Oni udišu jake kisele gasove (LaVinka and Park, 2012)
Oni ne osećaju kapi kiseline (Park et al., 2008)
Oni ne vole štipanje i opekotine (Poulson et al., 2020)

Naš doživljaj bola zavisi Osnove nocicepcije predstavljene su u Kavaliers (1988); Lewin, Lu, and Park (2004); Tracey (2017).
Međutim, kod njih nisu toliko brojni (Smith, Park, and Lewin, 2020)
Umesto da aktiviraju određene nociceptore (Smith et al., 2011)
Nekoliko sisara koji hiberniraju (Liu et al., 2014)
Ptice koje raznose seme (Jordt and Julius, 2002)
Ljudi su otporni na nepetalakton (Melo et al., 2021)
Miševi iz reda *Onychomys* (Rowe et al., 2013)
Početkom dvadesetog veka (Sherrington, 1903)
Posle više od stotinu godina Odličan prikaz nocicepcije i bola – Sneddon (2018); Williams et al. (2019).
Drugi su urođeno neosetljivi (Cox et al., 2006; Goldberg et al., 2012)
Jedan dečak iz Pakistana (Cox et al., 2006)
Toplo preporučujem knjigu (Cowart, 2021)
Medicinska struka dugo nije verovala ljudima (naročito ženama) *The Lady's Handbook for Her Mysterious Illness* autorke Sarah Ramey (2020) i *Doing Harm* autorke Maya Dusenbery (2018) odlične su knjige na ovu temu.
Ona je toliko rasprostranjena i konstantna pojava Članak o bolu životinja – Sneddon (2018).
Ispoljavanje bola (Bateson, 1991)
Za mnoge filozofe (Sullivan, 2013)
Međutim, i dalje se vode žučne rasprave (Sneddon et al., 2014)
Do osamdesetih godina prošlog veka (Anand, Sippell, and Aynsley-Green, 1987)
Ta razlika „je zaostali pokušaj" (Broom, 2001)
Ljudi imaju receptore za ukus (Li, 2013; Lu et al., 2017)
Početkom dvehiljaditih, Lin Snedon (Sneddon, Braithwaite, and Gentle, 2003a, 2003b)
When fish nociceptors fire (Dunlop and Laming, 2005; Reilly et al., 2008)

I zaista, kad ribe stisnete (Bjørge et al., 2011; Mettam et al., 2011)
U jednom eksperimentu, Snedon je pokazala (Sneddon, 2013)
U drugom istraživanju, Sara Milsop (Millsopp and Laming, 2008)
„Postoji jednako mnogo dokaza“ (Braithwaite, 2010)
Ipak, grupa glasnih kritičara (Rose et al., 2014; Key, 2016)
Da biste stekli utisak o raspravi (Rose et al., 2014; Key, 2016; Sneddon, 2019)
„Ribama su neurološki omogućeni“ (Rose et al., 2014)
Da ironija bude veća, ta tvrdnja (Braithwaite and Droege, 2016)
I po istoj manjkavoj logici (Dinets, 2016)
Poređenja radi, krabe i jastozi (Marder and Bucher, 2007)
Ono što je bitno nije samo ukupni broj (Garcia-Larrea and Bastuji, 2018)
Međutim, takvih veza ima daleko manje (Adamo, 2016, 2019)
Elvud i njegova koleginica (Appel and Elwood, 2009; Elwood and Appel, 2009)
Kako navodi Elvod, te činjenice (Elwood, 2019)
Međutim, treba naglasiti da su Adamo, Snedon i Elvud (Sneddon et al., 2014)
Evolucija je usmerila (Chittka and Niven, 2009)
Neki naučnici pretpostavljaju (Bateson, 1991; Elwood, 2011)
Inženjeri su konstruisali robote (Stiehl, Lalla, and Breazeal, 2004; Lee-Johnson and Carnegie, 2010; Ikinamo, 2011)
1**Međutim, oni takođe imaju** (Hochner, 2012)
1**I, kao što je Evropska unija navela** (European Parliament, Council of the European Union, 2010)
1**Ona je počela da premošćuje taj jaz** (Crook et al., 2011)
Još je čudnije otkriće (Crook, Hanlon, and Walters, 2013)
Prelazak celim telom (Crook et al., 2014)
Kruk je to potvrdila eksperimentom (Alupay, Hadjisolomou, and Crook, 2014)

Hobotnice ponekad otkinu pipak (Alupay, Hadjisolomou, and Crook, 2014)
U svojoj najnovijoj studiji (Crook, 2021)
„Mogli bismo jednostavno da prihvatimo“ (Chatigny, 2019)
Primera radi, insekti (Eisemann et al., 1984)
Takvi oblici ponašanja „snažno ukazuju“ (Eisemann et al., 1984)

5. POGLAVLJE
Baš sveže 168
Toplota

Hibernacija nije san (Geiser, 2013)
Ta dva procesa su toliko različita (Daan, Barnes, and Strijkstra, 1991)
Srce, koje leti kuca (Andrews, 2019)
Međutim, veverica s trinaest pruga (Matos-Cruz et al., 2017)
Vanesa Matos-Kruz, saradnica Gračeve (Matos-Cruz et al., 2017)
Granice te zone nisu ujednačene Temperaturni opsezi koje životinje podnose predmet su članka autora McKemy (2007); Sengupta and Garrity (2013).
Životinje imaju razne senzore (Matos-Cruz et al., 2017; Hoffstaetter, Bagriantsev, and Gracheva, 2018)
U slučaju pacova, to se dešava na temperaturi (Hoffstaetter, Bagriantsev, and Gracheva, 2018)
Ribe izgleda da uopšte nemaju TRPM8 (Gracheva and Bagriantsev, 2015)
Matos-Kruz je otkrila (Matos-Cruz et al., 2017)
Ljudi imaju verziju kanala TRPM8 (Key et al., 2018)
Senzor TRPV(Hoffstaetter, Bagriantsev, and Gracheva, 2018)
Tokom eksperimenata s grejnim pločama koje je radila Gračeva (Laursen et al., 2016)
Saharski srebrni mrav (Gehring and Wehner, 1995; Ravaux et al., 2013)

Vrsta muve *Chionea lutescens* (Hartzell et al., 2011)
pet milimetara iznad moje kože (Corfas and Vosshall, 2015)
Kad bi mi sletela na glavu (Heinrich, 1993)
Neuronaučnik Marko Galio pokazao je (Simões et al., 2021)
Ribe, od sićušnih larvi (Wurtsbaugh and Neverman, 1988; Thums et al., 2013)
Crvi *Paralvinella sulfincola* koji žive (Bates et al., 2010)
Leptiri koji na suncu zagrevaju (Tsai et al., 2020)
Čak su i embrioni kornjače (Du et al., 2011)
Desetog avgusta 1925. u jedanaest i dvadeset pre podne (Schmitz and Bousack, 2012)
Otkriveno je da tih crnih insekata (Linsley, 1943)
Jednog leta Linsli ih je video (Linsley and Hurd, 1957)
Kad insekti stignu na mesto požara (Schmitz, Schmitz, and Schneider, 2016)
Iako njihove antene (Schütz et al., 1999)
Atomi i molekuli (Dusenbery, 1992; Schmitz, Schmitz, and Schneider, 2016)
Kad je zoolog Helmut Šmic (Schmitz and Bleckmann, 1998)
Na osnovu te udaljenosti (Schmitz and Bousack, 2012)
Dok lete, klepetanje krilima (Schneider, Schmitz, and Schmitz, 2015)
Vrsta insekta *Melanophila* (Schmitz, Schmitz, and Schneider, 2016)
Izuzetak je vrsta (Bisoffi et al., 2013)
Toplota takođe (Bryant and Hallem, 2018; Bryant et al., 2018)
Većina životinjskih vrsta (Windsor, 1998; Forbes et al., 2018)
Nije ni čudo što (Lazzari, 2009; Chappuis et al., 2013; Corfas and Vosshall, 2015)
Njegovi toplotni senzori (Kürten and Schmidt, 1982)
Elena Gračeva je proučavala te neurone (Gracheva et al., 2011)
En Kar i Vinsent Salgado (Carr and Salgado, 2019)
Jamice osetljive na toplotu (Goris, 2011)

Ipak, Elena Gračeva je otkrila (Gracheva et al., 2010)
Niko nije dao tačan odgovor (Ros, 1935)
Zvečarke napadaju tople žrtve (Noble and Schmidt, 1937)
Čak i urođeno slepa zvečarka (Kardong and Mackessy, 1991)
Oni reaguju čim temperatura (Bullock and Diecke, 1956)
Ta neverovatna osetljivost znači (Ebert and Westhoff, 2006)
Tu se ta dva toka spajaju (Hartline, Kass, and Loop, ; Newman and Hartline, 1982)
„Pogrešno je smatrati" (Goris, 2011)
Kad su u opasnosti, one podižu rep (Rundus et al., 2007)
Dobio je zrnaste slike (Bakken and Krochmal, 2007)
Porebarke su obično orijentisane (Schraft, Bakken, and Clark, 2019)
Na kineskom ostrvu Šedao (Shine et al., 2002)
Kineski herpetolog Ježong Tang (Chen et al., 2012)
Nervi u njihovim membranama (Goris, 2011)
To je pokazao ekolog Bert Kotler (Bleicher et al., 2018; Embar et al., 2018)
Međutim, Šraft je otkrio da porebarke s prekrivenim očima (Schraft and Clark, 2019)
Šraft im je bacio mrtve guštere (Schraft, Goodman, and Clark, 2018)
Godine 2013, Vivijana Kadena (Cadena et al., 2013)
On i Baken su objavili rezultate svojih istraživanja (Bakken et al., 2018)
Kreger je otkrio (Gläser and Kröger, 2017; Kröger and Goiricelaya, 2017)
Njegov tim je uspešno dresirao tri psa (Bálint et al., 2020)

6. POGLAVLJE
Gruba slika
Kontakt i strujanje

Selka je imala nedelju dana (Monterey Bay Aquarium, 2016)
One ipak imaju najgušće krzno (Kuhn et al., 2010)

Da bi zadržale toplotu (Costa and Kooyman, 2011)
One stalno rone (Yeates, Williams, and Fink, 2007)
Osetljivost šapa (Radinsky, 1968)
Različite oblasti somatosenzornog korteksa (Wilson and Moore, 2015)
U nameri da proceni za šta su te rukavice (Strobel et al., 2018)
Isto tako, Strobel je otkrila da ljudi (Strobel et al., 2018)
Pod vodom će ostati (Thometz et al., 2016)
Dodir spada u mehanička čula Članak o čulu dodira autora Prescott and Dürr (2015).
Postoji nekoliko vrsta tih ćelija Razne vrste senzora za dodir tema su članka autora Zimmerman, Bai, and Ginty (2014); Moayedi, Nakatani, and Lumpkin (2015).
Međutim, još uvek nije poznato (Walsh, Bautista, and Lumpkin, 2015)
U jednom eksperimentu (Carpenter et al., 2018)
Na drugom testu (Skedung et al., 2013)
Takvi neverovatni podvizi (Prescott, Diamond, and Wing, 2011)
Mark Ratland, koji je predvodio (Skedung et al., 2013)
Krtica sa zvezdastim nosom Katanijin prikaz proučavanja krtica sa zvezdastim nosom – Catania (2011).
Naučnici su dugo razmišljali (Catania, 1995b)
Embrion krtice sa zvezdastim nosom (Catania, Northcutt, and Kaas, 1999)
Krtičin somatosenzorni korteks (Catania et al., 1993)
Oko pet procenata krtica sa zvezdastim nosom (Catania and Kaas, 1997b)
Jedanaesti par krakova (Catania, 1995a)
Snimajući krticu (Catania and Kaas, 1997a)
Analizirajući taj snimak (Catania and Remple, 2004, 2005)
Kokoške, koje se u velikoj meri oslanjaju (Gentle and Breward, 1986)
Ali nekim patkama (Schneider et al., 2014, 2017)

„Zamislite da ste za doručak dobili“ (Birkhead, 2013, p.)
U poređenju s drugim patkama (Schneider et al., 2019)
Međutim, 1995. godine Teunis Pirsma (Piersma et al., 1995)
Taj jednostavan eksperiment je otkrio (Piersma et al., 1998)
Ibisi primenjuju tu metodu (Cunningham, Castro, and Alley, 2007; Cunningham et al., 2010)
Ram Gal i Frederik Libersat (Gal et al., 2014)
Prilepuše su pretvorile (Cohen et al., 2020)
Glavoč okruglak (Hardy and Hale, 2020)
Aethia pygmaea (Seneviratne and Jones, 2008)
Kad je Sampat Seneviratne stavio (Seneviratne and Jones, 2008)
Verovatnije je da su to senzori za dodir (Cunningham, Alley, and Castro, 2011)
Jasno je da su ptice nastale (Persons and Currie, 2015)
Moguće je da je krzno sisara (Prescott and Dürr, 2015)
To su vibrise Rad na temu vibrisa sisara autora Prescott, Mitchinson, and Grant (2011).
To zamahivanje brkovima (Bush, Solla, and Hartmann, 2016)
Glodar stalno snima (Grant, Breakell, and Prescott, 2018)
Ako oseti nešto (Grant, Sperber, and Prescott, 2012)
Kad okrećemo glavu (Arkley et al., 2014)
Sisari koriste brkove (Mitchinson et al., 2011)
Grant je pokazala da oposum (Mitchinson et al., 2011)
Disk se sastoji od mišića (Marshall, Clark, and Reep, 1998)
Ima ih oko dve hiljade Vibrise lamantina opisane su u radu autora Reep and Sarko (2009); Bauer, Reep, and Marshall (2018).
Međutim, kad dođe vreme da se nešto pojede (Marshall et al., 1998)
Godine 2012, Bauer je radio eksperiment (Bauer et al., 2012)
Još nekoliko vrsta sisara (Crish, Crish, and Comer, 2015; Sarko, Rice, and Reep, 2015)
Lamantinima te dlake služe (Reep, Marshall, and Stoll, 2002)

Bauer i njegove kolege (Gaspard et al., 2017)
Sprauts ima stotinjak brkova na licu (Hanke and Dehnhardt, 2015)
Sprauts pomoću njih (Murphy, Reichmuth, and Mann, 2015)
Foke stalno održavaju toplotu tih brkova (Dehnhardt, Mauck, and Hyvärinen, 1998)
Tu sposobnost otkrio je tek 2001. godine (Dehnhardt et al., 2001)
Tim iz Rostoka pokazao je (Hanke et al., 2010)
Samo na osnovu takvog opažanja (Wieskotten et al., 2010)
Ona može da razlikuje strujanje (Wieskotten et al., 2011)
U jednom eksperimentu, Henri (Niesterok et al., 2017)
Lateralni sistem imaju Članak o lateralnom sistemu autora Montgomery, Bleckmann, and Coombs (2013).
Nakon što su opisali te pore (Dijkgraaf, 1989)
Tridesetih godina dvadesetog veka, biolog (Dijkgraaf, 1989)
Godine 1998, ihtiolog Bruno Hofer (Hofer, 1908)
Ako ona pliva ka zidu akvarijuma (Dijkgraaf, 1963)
Godine 1963, Dijkgraf je opisao (Dijkgraaf, 1963)
Lateralni sistem omogućava (Webb, 2013; Mogdans, 2019)
Ribe u jatima koriste lateralni sistem (Partridge and Pitcher, 1980)
Slepe ribe takođe mogu da plivaju u jatu (Pitcher, Partridge, and Wardle,)
Iako sve ribe imaju (Webb, 2013)
Ribe koje se hrane na površini (Mogdans, 2019)
Ribe Hemiramphidae imaju izbačenu donju vilicu (Montgomery and Saunders, 1985)
Meksička tetra (Astyanax mexicanus) izgubila je vid (Yoshizawa et al., 2014; Lloyd et al., 2018)
Neke meksičke tetre su razvile (Patton, Windsor, and Coombs, 2010)
Dok ga je posmatrala pod mikroskopom (Haspel et al., 2012)
Soares je utvrdila da su ti džojstici (Haspel et al., 2012)

Kako je otkrila, kvržice su (Soares, 2002)
Životinje iz reda rokodila – aligatori, krokodili (Soares, 2002)
Ipak, telo im je (Leitch and Catania, 2012)
Mnoge vrste zmija imaju na hiljade (Crowe-Riddell, Williams, et al., 2019)
***Spinosaurus*, ogroman dinosaurus s jedrom na leđima** (Ibrahim et al., 2014)
Daspletosaurus*, blizak rođak *tiranosaurusa, (Carr et al., 2017)
Da bi otkrila da li (Kane, Van Beveren, and Dakin, 2018)
Ti rezultati ukazuju na mogućnost da stojeći (Kane, Van Beveren, and Dakin, 2018)
Međutim, filoplume su naročito važne (Necker, 1985; Clark and de Cruz, 1989)
To se retko dešava, delimično zato što ptica dobija (Brown and Fedde, 1993)
Prekrivena su oskudnim dlačicama (Sterbing-D'Angelo et al., 2017)
Kad je Sterbing namazala krila slepog miša (Sterbing-D'Angelo and Moss, 2014)
Godine 1960, tovar banana Bartov opis proučavanja tigrastog pauka lutalice – Barth (2002).
Noge su mu prekrivene stotinama (Barth, 2015)
Ukoliko trči (Seyfarth, 2002)
Savija ih čak i vazduh (Barth and Höller, 1999)
Pauk hvata muvu u vazduhu (Klopsch, Kuhlmann, and Barth, 2012, 2013)
Mnogi i sami imaju senzore za strujenje vazduha (Casas and Dangles, 2010)
. On je brz, ali Kasas je otkrio (Dangles, Casas, and Coolen, 2006; Casas and Steinmann, 2014)
„Paukovi mogu da osete opasnost" (Di Silvestro, 2012)
Te dlačice su stotinu puta (Shimozawa, Murakami, and Kumagai, 2003)

Primera radi, . godine Jirgen Tauc (Tautz and Markl,)
Trideset godina kasnije, Tauc je pokazao (Tautz and Rostás, 2008)

7. POGLAVLJE
Podrhtavanje tla
Vibracije na površini

Skupili su gomilu jaja (Warkentin, 1995)
Ti eksperimenti su pokazali (Cohen, Seid, and Warkentin, 2016)
Varkentin je snimila različite vibracije (Warkentin, 2005; Caldwell, McDaniel, and Warkentin, 2010)
Oni jasno opažaju svoju okolinu Opis izleganja žabljih punoglavaca koji imaju sposobnost primanja signala iz okruženja – Warkentin (2011).
Međutim, oni ne reaguju na zmije (Jung et al., 2019)
Džang je napravila improvizivani okretač (Jung et al., 2019)
Dok su ih posmatrali infracrvenim kamerama (Caldwell, McDaniel, and Warkentin, 2010)
Mužjaci kraba gudača (Takeshita and Murai, 2016)
Termiti vojnici udaraju glavom (Hager and Kirchner, 2013)
Stenice gazivode – insekti koji klize (Han and Jablonski, 2010)
Naučnici to zovu vibracije koje se prenose kroz podlogu (Hill, 2009; Hill and Wessel, 2016; Mortimer, 2017)
Za razliku od njih, površinski talasi (Hill, 2014)
„Mi smo se susreli s tim ali“ Uticajan članak autorke Peggy Hill o komunikaciji putem vibracija – Hill (2008). Navedeni citat se nalazi na 2. strani.
Brzim grčenjem mišića Prikaz komunikacije insekata putem vibracija – Cocroft and Rodríguez (2005); Cocroft (2011).
Insekti koriste to svojstvo (Cokl and Virant-Doberlet, 2003)
Danas Kokroft ima biblioteku Potražite je na adresi treehoppers.insectmuseum.org.

Rogati cvrčak može da proizvede (Cocroft and Rodríguez, 2005)
Neke bebe proizvode sinhronizovane vibracije (Cocroft, 1999)
Neke majke proizvode vibracije (Hamel and Cocroft, 2012)
Oni se udvaraju jedan drugom (Legendre, Marting, and Cocroft, 2012)
Mnogi insekti ometaju signale (Eriksson et al., 2012; Polajnar et al., 2015)
Moljci Drepana arcuata trljaju (Yadav, 2017)
Mravi Pseudomyrmex ferruginea žestoko brane (Hager and Krausa, 2019)
Godine 1949, tri decenije pre (Ossiannilsson, 1949)
„Blago remećenje peska" Braunelov opis proučavanja peščanih škorpiona – Brownell (1984).
Braunel i Farli su ispitali tu pretpostavku (Brownell and Farley, 1979c)
Njegovi senzori nalaze se u vrhovima nogu (Brownell and Farley, 1979a)
Čim se to desi (Brownell and Farley, 1979b)
Mogu li životinje da osete zemljotres (Woith et al., 2018)
Ne može se reći da mravi imaju (Fertin and Casas, 2007; Martinez et al., 2020)
Tada bacaju pesak na mrava (Mencinger-Vračko and Devetak, 2008)
Ken Katanija – isti onaj istraživač (Catania, 2008; Mitra et al., 2009)
„ako se po zemlji udara" (Darwin, 1890)
S druge strane, izuzetno je osetljiva (Mason, 2003)
Zlatna krtica se hrani noću (Lewis et al., 2006)
Piter Narins je ukazao (Narins and Lewis, 1984; Mason and Narins, 2002)
Zlatna krtica ima toliko veliki maleus (Mason, 2003)
„Ležanje koje dokumentarci o prirodi" (Hill, 2008, p. 120)

Početkom devedesetih godina dvadesetog veka, Kejtlin O'Konel Autorkin opis proučavanja slonova – O'Connell (2008).

Delovalo je da životinje osluškuju (O'Connell-Rodwell, Hart, and Arnason, 2001)

Godine 2012, O'Konel se vratila (O'Connell-Rodwell et al., 2006)

„Sve ove godine planiranja" (O'Connell, 2008, p. 180)

Posle nekoliko godina, ona je ponovila (O'Connell-Rodwell et al., 2007)

Te vibracije mogu da se prenose (O'Connell, Arnason, and Hart, 1997; Günther, O'Connell-Rodwell, and Klemperer, 2004)

Dok smo se mi širili po planeti (Smith et al., 2018)

Između trideset i šezdeset miliona bizona (Phippen, 2016)

„Lakote... su volele zemlju" (Standing Bear, 2006, p. 192)

Paukovi su nastali Odlična knjiga o paukovoj svili i njenoj evoluciji – Brunetta and Craig (2012).

Iako lagana i elastična (Agnarsson, Kuntner, and Blackledge, 2010)

Kružna mreža je zamka (Blackledge, Kuntner, and Agnarsson, 2011)

Na tom mestu (Masters, 1984)

Oni verovatno mogu da zaključe (Landolfa and Barth, 1996)

Oni mogu da procene veličinu (Robinson and Mirick, ; Suter,)

Ukoliko žrtva prestane da se kreće (Klärner and Barth, 1982)

Sitan pauk vrste *Argyrodes* (Vollrath, 1979a, 1979b)

Neke stenice iz porodice *Reduviidae* (Wignall and Taylor, 2011)

***Portia*, pauk-skakač** (Wilcox, Jackson, and Gentile, 1996)

„mali pleteni svet" (Barth, 2002, p. 19)

Gađajući pojedinačne svilene niti (Mortimer et al., 2014)

On to može da radi dok plete novu (Mortimer et al., 2016)

Zoolog Takeši Vatanabe pokazao je (Watanabe, 1999, 2000)

Pauci pletači takođe zatežu (Nakata, 2010, 2013)
Paukova mreža nije samo Odličan prikaz paukovih mreža kao primera proširene spoznaje – Japyassú and Laland (2017).
Biofizičarka Nataša Mhatre pokazala je (Mhatre, Sivalinghem, and Mason, 2018)

8. POGLAVLJE
Pomno slušamo
Zvuk

Da bi to proverio Pejnov opis sopstvenog proučavanja sova kukuvija – Payne ( ).
U naredne četiri godine (Payne,)
Kad miš šušne (Dusenbery, 1992)
Struktura uva sove kukuvije (Konishi, , 2012)
Pošto im se trepljaste ćelije regenerišu (Krumm et al., 2017)
Masakazu Koniši i Erik Knudsen (Knudsen, Blasdel, and Konishi, 1979)
Međutim, sovine uši (Payne,)
Na osnovu tih razlika u brzini (Carr and Christensen-Dalsgaard, 2015, 2016)
Vilijam Stebins je to vrlo lepo sažeo Star ali dobar prikaz sluha životinja – Stebbins (1983). Navedeni citat se nalazi na 1. strani.
Srećom, sovino telo je prekriveno (Weger and Wagner, 2016; Clark, LePiane, and Liu, 2020)
Šum koji ona pravi (Konishi, 2012)
Ti mali skakutavi glodari (Webster and Webster, 1980)
Zato ih sove kukuvije teško (Webster, 1962; Stangl et al., 2005)
Oni čak čuju zvuk (Webster and Webster,)
Njima su se takođe razvile uši Prikaz ušiju insekata u radu autora Fullard and Yack (1993); Göpfert and Hennig (2016).
Na kraju krajeva, prvi isekti (Göpfert and Hennig, 2016)
Oni su morali da razviju uši (Robert, Mhatre, and McDonagh, 2010)

Uši se nalaze na kolenima (Göpfert, Surlykke, and Wasserthal, 2002; Montealegre-Z et al., 2012)
Komarci čuju pomoću svojih antena (Menda et al., 2019)
Gusenice monarha čuju (Taylor and Yack, 2019)
Vrsta skakavca *Pneumoridae* (Yager and Hoy, 1986; Van Staaden et al., 2003)
„Kasnijih godina otkrivene su" (Pye, 2004)
Uši insekata se toliko razlikuju (Fullard and Yack, 1993)
Shodno tome, mnogi insekti (Strauß and Stumpner, 2015)
Mnogi leptiri, uključujući (Lane, Lucas, and Yack, 2008)
Džejn Jek je pokazala (Fournier et al., 2013)
Fosilizovani insekti koji su (Gu et al., 2012)
Međutim, Danijel Robert toliko detaljno (Robert, Amoroso, and Hoy, 1992)
S preciznošću od jednog stepena, ona može (Mason, Oshinsky, and Hoy, 2001; Müller and Robert, 2002)
Međutim, Robert i njegov mentor (Miles, Robert, and Hoy, 1995)
Kroz nekoliko mukotrpnih istraživanja, Barbara Veb (Webb, 1996)
Veb je čak napravila jednostavnog robota (Webb, 1996)
To se desilo u rasponu od dvadeset generacija (Zuk, Rotenberry, and Tinghitella, 2006; Schneider et al., 2018)
Bila je to žaba tungara (Ryan, 1980)
Rajan to zna zato što je (Ryan, 1980)
Ženke se skoro uvek odlučuju za mužjake (Ryan et al., 1990)
Rajan je ustanovio da je unutrašnje uvo žabe (Ryan and Rand, 1993)
Rajan je otkrio pravu istinu (Ryan and Rand, 1993)
To otkriće je potpuno preokrenulo Rajanovu teoriju (Ryan and Rand, 1993)
Rajan tu pojavu zove „senzorna eksploatacija" Rajanov opis sopstvenog istraživanja tungara žaba – Ryan (2018).
Međutim, Aleksandra Basolo je otkrila (Basolo, 1990)

Tatl i Rajan su pokazali (Tuttle and Ryan, 1981)
Rajanova studentkinja Rejčel Pejdž (Page and Ryan, 2008)
Još jedna Rajanova studentkinja, Himena Bernal (Bernal, Rand, and Ryan, 2006)
Ljubitelji ptica su dugo pretpostavljali Prikaz ptičjeg sluha u radu autora Dooling and Prior (2017).
Ptici rugalici nije potrebna (Birkhead, 2013)
Šezdesetih godina prošlog veka, pre nego što je radio (Konishi, 1969)
Od sedamdesetih godina prošlog veka naovamo (Dooling, Lohr, and Dent, 2000)
Duling je to potvrdio jednim (Dooling et al., 2002)
Kad je Bet Vernaleo (Vernaleo and Dooling, 2011)
Potpuno su izmešali redosled (Lawson et al., 2018)
pesma zebraste zebe (Dooling and Prior, 2017)
Ne ponašaju se sve vrste (Fishbein et al., 2020)
Međutim, Dulingova koleginica Nora Prajor (Prior et al., 2018)
On i njegove kolege stavili su elektrode (Lucas et al., 2002)
Isto tako, uši mogu imati izuzetnu (Henry et al., 2011)
Lukas je otkrio da im se na jesen (Lucas et al., 2007)
Sluh belogrudog brgljeza (lat. *Sitta carolinensis*) (Lucas et al., 2007)
To bi moglo da objasni zašto (Noirot et al., 2009)
Lukas i njegova koleginica Megan Gol (Gall, Salameh, and Lucas, 2013)
2**Možda je s godinama slabio** (Caras, 2013)
2**Mužjaci ribe *Porichthys notatus*** (Sisneros, 2009)
2**Žabe *Hyla cinerea*** (Gall and Wilczynski, 2015)
Šezdesetih godina prošlog veka (Kwon, 2019)
Jedna, zasnovana na audio-zapisima koje je Pejn (Payne and McVay,)
Druga je pokazala da kitovi perajari (Payne and Webb,)
Izvor je otkriven tek (Schevill, Watkins, and Backus, 1964)

Ispod toga su frekvencije (Narins, Stoeger, and O'Connell-Rodwell, 2016)
Znajući da kitovi perajari (Payne and Webb,)
Među spektrogramima (Clark and Gagnon, 2004)
Prvog dana Klark je otkrio (Costa, 1993)
Geofizičari svakako mogu da iskoriste (Kuna and Nábělek, 2021)
Osim toga, on pretpostavlja da te životinje (Tyack and Clark, 2000)
To možda deluje apsurdno (Goldbogen et al., 2019)
Ta prastara stvorenja (Mourlam and Orliac, 2017)
Kitovi pločani su toliko narasli (Shadwick, Potvin, and Goldbogen, 2019)
Maja 1984. godine, Kejti Pejn Autorkin opis sopstvenog proučavanja slonova – Payne (1999).
„Bilo je to kao da imate osećaj" (Payne, 1999, p. 20)
Međutim, kad je Pejn ubrzala snimak (Payne, Langbauer, and Thomas, 1986)
Ona je prihvatila i 1986. godine (Poole et al., 1988)
Na manjim udaljenostima (Poole et al., 1988)
Nekoliko sati posle zalaska sunca (Garstang et al., 1995)
Njen rad jasno ukazuje (Ketten, 1997)
Te ogromne životinje (Miles, Robert, and Hoy, 1995)
U zimu. (Sidebotham,)
Nekih stotinu godina kasnije (Noirot, 1966; Zippelius, ; Sales, 2010)
Mladunci koji su odvojeni (Sewell,)
Kad golicate pacova (Panksepp and Burgdorf, 2000)
Ričardsonove veverice (Wilson and Hare, 2004)
Mužjaci miševa koji njuškaju (Holy and Guo, 2005)
Privučene tim serenadama (Neunuebel et al., 2015)
On se odnosi na zvučne talase Prikaz komunikacije ultrazvukom – Arch and Narins (2008).
Pas čuje kHz (Heffner, 1983; Heffner and Heffner, 1985, 2018; Kojima, 1990; Ridgway and Au, 2009; Reynolds et al., 2010)

Riki i Henri Hefner (Heffner and Heffner, 2018)
Podzemne životinje su upadljiv izuzetak (Heffner and Heffner, 2018)
To znači da se ultrazvučni zov (Arch and Narins, 2008)
Iz istog razloga uređaji (Aflitto and DeGomez, 2014)
To je primetila Marisa Ramzijer (Ramsier et al., 2012)
Severnoamerički plavogrli kolibri (Pytte, Ficken, and Moiseff, 2004)
Nekoliko drugih kolibrija (Olson et al., 2018)
Ta narandžasta žaba ne čuje (Goutte et al., 2017)
Više od polovine od 160.000 vrsta Borba između insekata i slepih miševa opisana je u delu autora Conner and Corcoran (2012).
Veliki voskov moljac (Moir, Jackson, and Windmill, 2013)
Neki noćni leptiri ispuštaju ultrazvučni zov (Nakano et al., 2009, 2010)
Najverovatnije se radi (Kawahara et al., 2019)
U najvećem broju slučajeva, uši noćnih leptira (Kawahara et al., 2019)

9. POGLAVLJE
Nemi svet dovikuje
Odjeci

Osluškujući povratni eho Detaljan prikaz eholokacije u delu autora Surlykke et al. (2014).
Oštrooki predatori poput ptica (Boonman et al., 2013)
Situacija je, zapravo, obrnuta (Kalka, Smith, and Kalko, 2008)
Devedesetih godina osamnaestog veka, italijanski sveštenik Prikaz istorijata istraživanja eholokazije u delu autora Griffin ( ); Grinnell, Gould, and Fenton (2016).
Njegova zapažanja su ostala nepoznanica Klasično delo Donalda Grifina o istraživanju eholokacije – Griffin ( ).
Naučnici su više od jednog veka (Griffin,)

„Bili smo iznenađeni i oduševljeni“ (Griffin, , p. 67)
Godinu dana kasnije, Grifin (Griffin and Galambos, 1941; Galambos and Griffin, 1942)
Međutim, njih dvojica su bili itekako ozbiljni (Griffin, 1944a)
Dok je sedeo pored jezera blizu Itake (Griffin, 1953)
To je način na koji slepi miševi love plen (Griffin, Webster, and Michael, 1960)
„Mašta naučnika“ (Griffin, 2001)
Poreklo eholokacije (Jones and Teeling, 2006)
To u suštini jednostavno fukncioniše. (Schnitzler and Kalko, 2001; Fenton et al., 2016; Moss, 2018)
Prosečan slepi miš može da opaža (Surlykke and Kalko, 2008)
Sve što se nalazi dalje od toga verovatno ne mogu da registruju (Holderied and von Helversen, 2003)
To je zato što slepi miševi usmeravaju (Jakobsen, Ratcliffe, and Surlykke, 2013)
Veliki smeđi šišmiš (Ghose, Moss, and Horiuchi, 2007)
Anemari Surlike je pokazala da (Hulgard et al., 2016)
Čak i takozvani slepi miš šaptač (Brinkløv, Kalko, and Surlykke, 2009)
Na taj način im se smanjuje osetljivost sluha (Henson, 1965; Suga and Schlegel,)
To se zove automatska kontrola jačine (Kick and Simmons, 1984)
Džon Retklif je pokazao (Elemans et al., 2011; Ratcliffe et al., 2013)
Džejms Simons i Sindi Mos su pokazali (Simmons, Ferragamo, and Moss, 1998)
Svaka ta frekvencija (Simmons and Stein, 1980; Moss and Schnitzler, 1995)
On zna gde se insekt nalazi (Zagaeski and Moss, 1994)
slepi miš mora stalno da podešava svoj sonar (Moss and Surlykke, 2010; Moss, Chiu, and Surlykke, 2011)
Slepi miševi mogu da jure kroz reljefne izbočine u pećini (Grinnell and Griffin, 1958)

Takvi haotični prostori predstavljaju posebne probleme (Surlykke, Simmons, and Moss, 2016)
Ona je takođe otkrila da (Chiu, Xian, and Moss, 2009)
Oni takođe često grupišu zvuke koje ispuštaju (Moss et al., 2006; Kothari et al., 2014)
vrsta *Cormura brevirostris* (Jung, Kalko, and von Helversen, 2007)
Inga Gejpel otkrila je da slepi miš (Geipel, Jung, and Kalko, 2013; Geipel et al., 2019)
Veliki smeđi šišmiši to postižu (Chiu and Moss, 2008; Chiu, Xian, and Moss, 2008)
Neki slepi miševi mogu da prepoznaju zvuke sonara (Yovel et al., 2009)
Ljiljak ribar (Suthers, 1967)
Istraživači su to nazvali „košmar koktel žurke“ (Ulanovsky and Moss, 2008; Corcoran and Moss, 2017)
To objašnjava brojne slučajeve iz prošlosti (Griffin,)
ceo jedan deo posvetio "nespretnim slepim miševima" (Griffin, , p. 160)
Oni mogu da razlikuju dva kvaliteta brusnog papira (Zagaeski and Moss, 1994)
Međutim, oko stotinu šezdeset vrsta (Schnitzler and Denzinger, 2011; Fenton, Faure, and Ratcliffe, 2012)
Hans-Ulrih Šnicler, koji (Kober and Schnitzler, 1990; von der Emde and Schnitzler,
1990; Koselj, Schnitzler, and Siemers, 2011)
Primera radi, veliki potkovičar (Schuller and Pollak, 1979; Schnitzler and Denzinger, 2011)
Druge vrste imaju sopstvene prepoznatljive frekvencije (Grinnell, 1966; Schuller and Pollak, 1979)
Međutim, Šnicler je 1967. godine otkrio (Schnitzler, 1967)
Sve to oni postižu (doslovno) (Schnitzler,)
Slepi miš potkovičar može da usmeri pažnju (Hiryu et al., 2005)

Kad ne izazivaju upalu disajnih puteva (Ntelezos, Guarato, and Windmill, 2016; Neil et al., 2020)

Taj zvučni oklop (Conner and Corcoran, 2012)

Tako slepi miševi mogu da čuju (Surlykke and Kalko, 2008)

Ostali im uzvraćaju (Dunning and Roeder, 1965)

Doroti Daning i Kenet Reder (Dunning and Roeder, 1965)

mnoge vrste velikih medonjica sadrže (Barber and Conner, 2007)

Godine 2009, Aron Korkoran (Corcoran, Barber, and Conner, 2009)

Kliktanje se preklapalo (Corcoran et al., 2011)

Međutim, za razliku od velikih medonjica (Barber and Kawahara, 2013)

Zahvaljujući svom nečujnom šapatu (Goerlitz et al., 2010; ter Hofstede and Ratcliffe, 2016)

Luna moljac bez repova ima prosečno (Barber et al., 2015)

Moljci su razvili izdužene repove (Rubin et al., 2018)

Donald Grifin je jednom prilikom opisao (Griffin, 2001)

Obe grupe su radi toga razvile eholokaciju Poređenje eholokacije kitova i slepih miševa u radu autora Au and Simmons (2007); Surlykke et al. (2014).

Nakon što je posmatrao pliskavice (Schevill and McBride, 1956)

Ken Noris je izveo (Norris et al., 1961)

Zato su istraživači koji proučavaju delfine Prikaz eholokacije delfina u radu autora Au (2011); Nachtigall (2016).

A field station in Hawaii's Whitlow Au's seminal work on dolphin sonar is Au (1993).

At Kāneʻohe Bay, where bottlenose dolphins (Au, 1993)

Delfini su mogli da razlikuju predmete (Au and Turl, 1983)

Životinja Kajna je pomoću svog sonara (Brill et al., 1992)

Pomoću eholokacije delfini mogu da traže (Pack and Herman, 1995; Harley, Roitblat, and Nachtigall, 1996)

Na vrhu glave delfin (Cranford, Amundin, and Norris, 1996)

Ulješura – najveći kit zuban (Madsen et al., 2002)
Sa 2decibela (Møhl et al., 2003)
Odontoceti presreću sopstvene odjeke (Mooney, Yamato, and Branstetter, 2012)
Kad su im potrebne dodatne informacije (Finneran, 2013)
Mogu da prilagode osetljivost (Nachtigall and Supin, 2008)
U jednom od prvih eksperimenata, Au je pokazao (Au, 1993)
Kasnije studije su pokazale da delfini pomoću eholokacije (Ivanov, 2004; Finneran, 2013)
Zvuk ima i drugačiju interakciju (Madsen and Surlykke, 2014)
Ako delfin na vama primenjuje eholokaciju (Au, 1996)
On može da razazna riblji mehur ispunjen vazduhom (Au et al., 2009)
Američka haringa *Alosa sapidissima* (Popper et al., 2004)
Pavel Goldin je pretpostavio (Gol'din, 2014)
Međutim, bez obzira na to što su retki (Tyack, 1997; Tyack and Clark, 2000)
Mogući način da se to otkrije (Johnson, Aguilar de Soto, and Madsen, 2009)
Jedan tim istraživača je 2003. godine (Johnson et al., 2004; Arranz et al., 2011; Madsen et al., 2013)
Keli Benoa-Berd i Vitlou Au pokazali su (Benoit-Bird and Au, 2009a, 2009b)
Kad Danijel Kiš klikće (Thaler et al., 2017)
Danas, u šestoj deceniji, Kiš (Kish, 2015)
Sitni sisari možda ispuštaju ultrazvučno kliktanje (Gould, 1965; Eisenberg and Gould, 1966; Siemers et al., 2009)
Neke vrste velikih ljiljaka (Boonman, Bumrungsri, and Yovel, 2014)
Uljašica, velika južnoamerička ptica (Brinkløv and Warrant, 2017; Brinkløv, Elemans, and Ratcliffe, 2017)
Prave čiope iz plemena Collocaliini, ptičice koje se hrane insektima (Brinkløv, Fenton, and Ratcliffe, 2013)
A, kao što vidimo na primeru Kiša (Thaler and Goodale, 2016)

Zašto foke ne koriste eholokaciju? (Schusterman et al., 2000)
barem od 9. godine (Diderot, 9; Supa, Cotzin, and Dallenbach, 1944; Kish, 1995)
Četrdesetih godina prošlog veka (Supa, Cotzin, and Dallenbach, 1944)
Supa je pomenuo ispitivanja slepih miševa (Griffin, 1944a)
Neuronaučnica Lor Tejler (Thaler, Arnott, and Goodale, 2011)
Bez vida, mozak (Norman and Thaler, 2019)
Pamćenje, štap (Thaler et al., 2020)

10. POGLAVLJE
Žive baterije
Električna polja

Oko tri stotine pedeset vrsta riba Osnove o električnim ribama potražite u radu autora Hopkins (2009); Carlson et al. (2019).
Pre oko pet hiljada godina Istorijat razvoja električnih riba prikazan je u radu autora Wu (1984); Zupanc and Bullock (2005); Carlson and Sisneros (2019).
Više informacija potražite (Finger and Piccolino, 2011)
To najbolje rade električne jegulje (Catania, 2019)
Godine 1800, ribari plemena Čajma (Catania, 2016)
Tim istraživača na čelu (de Santana et al., 2019)
Pražnjenje im je toliko slabo (Hopkins, 2009)
„Nemoguće je zamisliti" (Darwin, 1958, p.)
Hans Lisman je bio zoolog poreklom Lismanov uzbudljiv život opisan je u članku autora Alexander (1996).
Dok je bio u sudbonosnoj poseti (Turkel, 2013)
Godine 1951, Lisman je pomoću elektroda (Lissmann, 1951)
Registrujući te deformacije (Lissmann, 1958)
Lisman i Mejčin su objavili rezultate (Lissmann and Machin, 1958)
Riba može da registruje te razlike Odličan prikaz aktivne eholokacije u radu autora Lewis (2014); Caputi (2017).

Riba crni duh (von der Emde, 1990, 1999; von der Emde et al., 1998; Snyder et al., 2007)
„To može da ima zanimljive posledice“ (Hopkins, 2009)
Osim toga, ona je višesmerno čulo (Snyder et al., 2007)
Da bi udvostručio domet (Salazar, Krahe, and Lewis, 2013)
Oči riba-slonova (von der Emde and Ruhl, 2016)
Višesmerno opažanje koje omogućava elektrolokacija (Caputi et al., 2013)
Obavijaju telo oko tajanstvenih (Caputi, Aguilera, and Pereira, 2011)
Ejndžel Kaputi tvrdi (Caputi et al., 2013)
Električno čulo je *evoluiralo od* (Baker, 2019)
Elektroreceptori se razvijaju iz istih (Modrell et al., 2011; Baker, Modrell, and Gillis, 2013)
Pošto prepreke ne ometaju električna polja (Lewis, 2014)
One ne samo da su osetljive na provodljivost (von der Emde, 1990)
Naučnici su decenijama proučavali (Carlson and Sisneros, 2019)
Međutim, stvarna okruženja tih životinja Pojedini problemi terenskih istraživanja prikazani su u radu autora (2004).
Takve elektrode su se usavršavale s vremenom (Henninger et al., 2018; Madhav et al., 2018)
One se udvaraju, zauzimaju teritoriju Više informacija o elektrokomunikaciji potražite u radu autora Zupanc and Bullock (2005); Baker and Carlson (2019).
Oblik tih impulsa (Hopkins, 1981; McGregor and Westby, 1992; Carlson, 2002)
Jedan ritam mogao bi da bude privlačan (Hopkins and Bass, 1981)
Neuronaučnik Ted Bulok (Bullock, Behrend, and Heiligenberg,)
U knjizi *Sensory Exotica* (Hughes, 2001)
Neznatnim izmenama frekvencija (Bullock, 1969)
Kratkim, naglim povećanjem (Hagedorn and Heiligenberg, 1985)

Ako se dve ribe *Eigenmannia* sretnu (Bullock, Behrend, and Heiligenberg,)

***Mormyrinae* su čak dodatno izmenile** (Carlson and Arnegard, 2011; Vélez, Ryoo, and Carlson, 2018)

Karlson pretpostavlja da su te promene (Baker, Huck, and Carlson, 2015)

Mozak vrste pod nazivom Ubangi riba-slon (Nilsson, 1996; Sukhum et al., 2016)

Karlson je pokazao da jedna vrsta *Mormyrinae* (Arnegard and Carlson, 2005)

Istražuju peskovito dno (Amey-Özel et al., 2015)

Godine 1960, biolog R. V. Mari (Murray, 1960)

Nekoliko godina kasnije, Sven Dijkgraf (Dijkgraaf and Kalmijn, 1962)

Želatinasta masa u Lorencinijevim ampulama (Josberger et al., 2016)

Ispostavilo se da *sva* živa bića (Kalmijn,)

Ta polja su više hiljada puta slabija (Kalmijn, ; Bedore and Kajiura, 2013)

Kalmijn je to dokazao . godine (Kalmijn,)

Ajkule takođe grizu (Kalmijn, 1982)

Neke to rade od rođenja (Kajiura, 2003)

Električno čulo ajkule Prikaz pasivne elektrorecepcije dat je u članku autora Hopkins (2005, 2009).

Neke raže vrste *Myliobatoidei* pomoću električnih polja (Tricas, Michael, and Sisneros, 1995)

Osim toga, embrioni nekih ajkula (Kempster, Hart, and Collin, 2013)

Međutim, električno čulo ajkule funkcioniše samo (Kajiura and Holland, 2002)

Ajkula nanjuši hranu (Gardiner et al., 2014)

Iz tog razloga električna polja izazivaju (Dijkgraaf and Kalmijn, 1962)

Kad sipe vide da im se ajkule približavaju (Bedore, Kajiura, and Johnsen, 2015)

Umesto konusne njuške, ajkule čekićare (Kajiura, 2001)
Ona umnogome produžava domet električnog čula (Wueringer, Squire, et al., 2012a)
Ona je pokazala da im testera (Wueringer, Squire, et al., 2012b)
Vuringer je osnovala organizaciju (Wueringer, 2012)
Sposobnost otkrivanja električnih polja Prikaz elektroreceptcije u radu autora Collin (2019); Crampton (2019).
Približno jedna od šest vrsta kičmenjaka (Albert and Crampton, 2006)
Najmanje jedna vrsta delfina (Czech-Damal et al., 2012)
Slično tome, ne zna se kako ehidne (Gregory et al., 1989)
Njihov bliski srodnik, kljunar(Pettigrew, Manger, and Fine, 1998; Proske and Gregory, 2003)
This extensive cabal of electroreceptive critters (Baker, Modrell, and Gillis, 2013)
† **Ribe-noževi i ribe-slonovi su poseban slučaj** (Lavoué et al., 2012)
To se dešavalo približno u isto vreme (Lavoué et al., 2012)
S druge strane, vazduh je izolator (Czech-Damal et al., 2013)
To je gradijent potencijala u atmosferi (Feynman, 1964)
Privučene suprotnim naelektrisanjem (Corbet, Beament, and Eisikowitch, 1982; Vaknin et al., 2000)
Godine 2013, Robert i njegove kolege (Clarke et al., 2013)
Pčele su takođe naučile da brže (Clarke et al., 2013)
Umesto njih imaju elektroreceptore (Sutton et al., 2016)
Sama mogućnost široko rasprostranjene elektrorecepcije u vazduhu Prikaz elektrorecepcije u vazduhu dat je u radu autora Clarke, Morley, and Robert (2017).
Godine 2018, Robertova koleginica Erika Morli (Morley and Robert, 2018)
još jedan naučnik je pretpostavio da paukovi (Blackwall, 1830)
Protivnik je pobedio Ideja je ponovo zaživela u delu autora Gorham (2013).

11. POGLAVLJE
Oni znaju kuda idu
Magnetna polja

Svakog proleća, milijarde bogong leptira (Warrant et al., 2016)

Varant je shvatio da (Dreyer et al., 2018)

Sposobnost tih životinja, poznata kao magnetorecepcija Prikaz magnetorecepcije dat je u radu autora Johnsen and Lohmann (2005); Mouritsen (2018).

Merkel i njegovi studenti (Merkel and Fromme, 1958; Pollack, 2012)

Godine 1859, zoolog (Middendorff, 1855)

U odsustvu dokaza, čak je i Donald Grifin (Griffin, 1944b)

Merkel i Vilčko su našli dokaze (Wiltschko and Merkel, 1965; Wiltschko, 1968)

Otprilike u isto vreme (Brown, 1962; Brown, Webb, and Barnwell, 1964)

Zemljino magnetsko polje (Johnsen and Lohmann, 2005)

Mnogi naučnici, uključujući Vilčka (Wiltschko and Wiltschko, 2019)

Otkako su Merkelovi crvendaći načinili (Lohmann et al., 1995; Deutschlander, Borland, and Phillips, 1999; Sumner-Rooney et al., 2014; Scanlan et al., 2018)

Posle napornog noćnog lova na insekte (Holland et al., 2006)

Pošto ranu fazu života (Bottesch et al., 2016)

Golim slepim kučićima kompas služi (Kimchi, Etienne, and Terkel, 2004)

bogong leptiri se pomoću (Dreyer et al., 2018)

Da bi to proverila, Grejndžer (Granger et al., 2020)

Robins can also be sent off course (Bianco, Ilieva, and Åkesson, 2019)

Mali broj migracija je opasan Prikaz migracija kornjača dat jeu radu autora Lohmann and Lohmann (2019).

Do devedesetih godina prošlog veka niko (Carr, 1995)
Kao što je Loman pretpostavio (Lohmann, 1991)
Sredinom devedesetih godina prošlog veka (Lohmann and Lohmann, 1994, 1996)
Međutim, pošto je svaka vrsta kornjača (Lohmann, Putman, and Lohmann, 2008)
Sposobnosti kornjača naročito zadivljuju (Lohmann et al., 2001)
Glavate kornjače koje prežive (Lohmann et al., 2004)
Loman je to pokazao tako što je uhvatio jastoge (Boles and Lohmann, 2003)
Svake zime veliki slavuji (Fransson et al., 2001)
Primera radi, veliki trstenjak (Chernetsov, Kishkinev, and Mouritsen, 2008)
Mnoge životinje, među kojima su losos (Putman et al., 2013; Wynn et al., 2020)
Zahvaljujući toj sposobnosti, kornjače (Lohmann, Putman, and Lohmann, 2008)
Zelene kornjače koje se gnezde na ostrvu Asension (Mortimer and Portier, 1989)
Geomagnetsko polje neznatno se menja (Brothers and Lohmann, 2018)
0 **pokušaj da se nađu takve ćelije** (Johnsen, 2017)
0 **U vreme pisanja ove knjige** (Nordmann, Hochstoeger, and Keays, 2017)
Prva se vezuje za feromagnetni mineral (Wiltschko and Wiltschko, 2013; Shaw et al., 2015)
Sedamdesetih godina prošlog veka, naučnici su otkrili (Blakemore,)
Mnogi naučnici su decenijama bili uvereni (Fleissner et al., 2003, 2007)
Godine 2012, Kiz je objavio senzacionalnu studiju (Treiber et al., 2012)
Iste godine, još jedan tim (Eder et al., 2012)

Međutim, Kiz je opovrgao i to otkriće (Edelman et al., 2015)
Dok ajkula pliva (Paulin, 1995)
Francuski zoolog Kamil Viguje (Viguier, 1882)
Nekih stotinu trideset godina kasnije, Dejvid Kiz (Nimpf et al., 2019)
Treba spomenuti i da su 2011. (Wu and Dickman, 2012)
Radi se o dva molekula Kvalitetan prikaz hipoteze o radikalnom paru dat je u radu autora Hore and Mouritsen (2016).
On je poslao svoj rad (Schulten, personal communication, 2010)
Njega to nije pokolebalo (Schulten, Swenberg, and Weller,)
Godine 2000, Šulten i njegov student (Ritz, Adem, and Schulten, 2000)
Poznata kao klaster N (Mouritsen et al., 2005)
Klaster N dobija informacije (Heyers et al., 2007; Zapka et al., 2009)
Grupa CRY4 označena je (Einwich et al., 2020; Hochstoeger et al., 2020)
I, kako je to pokazao Mouritsen (Engels et al., 2014)
U jednoj studiji iz 1997. godine iznete su tvrdnje da medonosne pčele (Kirschvink et al., 1997)
Dve decenije kasnije, druga grupa (Baltzley and Nabity, 2018)
Godine 1999, tim američkih naučnika (Etheredge et al., 1999)
Godine 2002, bračni par Vilčko (Wiltschko et al., 2002)
Deceniju kasnije, Henrik Mouritsen (Hein et al., 2011; Engels et al., 2012)
Godine 2015, jedan američki tim (Vidal-Gadea et al., 2015; Qin et al., 2016)
Drugi istraživači nisu uspeli da ponove nijedan naveden eksperiment (Meister, 2016; Winklhofer and Mouritsen, 2016; Friis, Sjulstok, and Solov'yov, 2017; Landler et al., 2018)
Bejker je svoje rezultate objavio (Baker, 1980)
U skorije vreme, geofizičar Džozef Kiršvink (Wang et al., 2019)

Oni možda prilagođavaju svoje eksperimente u hodu Prikaz brojnih problema s naučnim eksperimentima koje je nemoguće ponoviti dat je u radu autora Aschwanden (2015).
Međutim, Sonke Džonsen, Ken Loman (Johnsen, Lohmann, and Warrant, 2020)
One je koriste samo kao pomoćno čulo Prikaz magnetorecepcije i ostalih načina navigacije životinja dat je u radu autora Mouritsen (2018).

12. POGLAVLJE
Svi prozori istovremeno
Sjedinjena čula

Venkataraman mi kaže da komarce Prikaz čulnih nadražaja na osnovu kojih komarci pronalaze svoje domaćine dat je u radu autora Wolff and Riffell (2018).
Međutim, nije delovao kad ga je Voshol (DeGennaro et al., 2013)
Promenivši taktiku, tim Lesli Voshol (McMeniman et al., 2014)
Kad je studentkinja Vosholove Moli Liu (Liu and Vosshall, 2019)
Tako najverovatnije deluje dietiltoluamid (Dennis, Goldman, and Vosshall, 2019)
Međutim, pre više hiljada godina (McBride et al., 2014; McBride, 2016)
Paukovi-skakači se oslanjaju na (Shamble et al., 2016)
Krtica zvezdaste njuške lovi plen (Catania, 2006)
Miris dominira životom mrava (Barbero et al., 2009)
Mirisi usmeravaju i ajkule (Gardiner et al., 2014)
Ubangi riba-slon proizvodi (von der Emde and Ruhl, 2016)
Zemljino magnetsko polje usmerava ptice pevačice i bogong leptire (Dreyer et al., 2018; Mouritsen, 2018)
Neki ljudi doživljavaju sinesteziju (Ward, 2013)

Primera radi, u patkolikom kljunu kljunara (Pettigrew, Manger, and Fine, 1998)

„ta čula se verovatno sjedinjuju“ (Wheeler, 1910, p. 510)

Električne ribe koje nauče (Schumacher et al., 2016)

Čak i bumbari mogu da razlikuju (Solvi, Gutierrez Al-Khudhairy, and Chittka, 2020)

Postoji propriocepcija, svest Prikaz propriocepcije dat je u radu autora Tuthill and Azim (2018).

Godine , devetnaestogodišnji mesar (Cole, 2016)

Kad su životinje u pokretu, čulni organi Prikaz koncepata eksaferencije, reaferencije i korolarnog pražnjenja dat je u radu autora Cullen (2004); Crapse and Sommer (2008).

Uzmimo za primer običnu kišnu glistu (Merker, 2005)

Međutim, nijedna životinja nije potpuno nepokretna (Ludeman et al., 2014)

Filozofi i naučnici su vekovima iznosili pretpostavke Kompletan istorijat ove ideje dat je u radu autora Grüsser (1994).

Od 1950, kopirane motorne komande (von Holst and Mittelstaedt, 1950; Sperry, 1950)

Oto-Joakim Griser je napisao odličan rad o nastanku (Grüsser, 1994)

Izučavajući ribe-slonove, naučnici su mnogo toga saznali Prikaz korolarnih pražnjenja u električnim ribama dat je u radu autora Sawtell (2017); Fukutomi and Carlson (2020).

Zato cvrčci mogu da isključe (Poulet and Hedwig, 2003)

Neki naučnici su izneli tvrdnje da je šizofrenija (Pynn and DeSouza, 2013)

Centralni nervni sistem hobotnice Prikaz neurobiološkog sistema hobotnice dat je u delu autora Grasso (2014); Levy and Hochner (2017).

„Hobotnica praktično ima devet mozgova“ (Crook and Walters, 2014)

Ona istovremeno dodiruje i opaža ukus (Graziadei and Gagne,)

Nezavisnost pijavki se jasno vidi (Nesher et al., 2014)

Svaka ganglija pijavke i odgovarajuća (Grasso, 2014)
Primera radi, neurobiolog Binjamin Hohner (Sumbre et al., 2006)
Međutim, Hohnerova koleginica Tamar Gutnik (Gutnick et al., 2011)
Leticija Zulo, još jedna članica Hohnerovog tima (Zullo et al., 2009; Hochner, 2013)
telo hobotnice „vrvi od mogućnosti" (Godfrey-Smith, 2016, p. 48)
Godfri-Smit odlično poredi (Godfrey-Smith, 2016, p. 105)
Hobotnica po svoj prilici ima *dva* (Grasso, 2014)

13. POGLAVLJE
Spasite tišinu, sačuvajte tamu
Ugroženi čulni doživljaji okruženja

3**Podstakli smo nastanak onoga** O šestom masovnon istrebljenju vrsta govori se u radu autora Kolbert (2014); Ceballos, Ehrlich, and Dirzo (2017).
Umesto da bolje upoznamo umvelt Prikaz zagađenja čula dat je u radu autora Swaddle et al. (2015); Dominoni et al. (2020).
Druge, sporije vrste (Spoelstra et al., 2017)
Grupa holandskih naučnika (D'Estries, 2019)
Godine 2001, kad su astronom Pjerantonio Činčano (Cinzano, Falchi, and Elvidge, 2001)
Kad su 2016. ažurirali atlas (Falchi et al., 2016)
Svake godine se za dva procenta povećava (Kyba et al., 2017)
„Pomisao da svetlost putuje" (Johnsen, 2012, p. 57)
Analizirajući slike koje generiše radar (Van Doren et al., 2017)
Godine 1886, neposredno pošto je Edison (Longcore and Rich, 2016)
Više od stotinu godina kasnije, ekolog (Longcore et al., 2012)

Smrt mnogih ptica (Gehring, Kerlinger, and Manville, 2009)

Međutim, noćna rasveta Prikaz svetlosnog zagađenja i njegovog štetnog uticaja na životinjski svet dat je u radu autora Sanders et al. (2021).

To se delimično objašnjava time što sami biolozi (Gaston, 2019)

Kad mladunci kornjača izađu iz gnezda (Witherington and Martin, 2003)

Veštačka svetlost može da bude pogubna (Owens et al., 2020)

Samo jedna ulična svetiljka (Degen et al., 2016)

Godine 2014, za potrebe jednog eksperimenta (Knop et al., 2017)

Insekti čije larve žive u vodi (Horváth et al., 2009)

Trepćuće sijalice mogu da izazovu glavobolju (Inger et al., 2014)

Nova generacija energetski efikasnih belih LED sijalica (Falchi et al., 2016; Longcore, 2018)

Da bi ih zaštitio, tim (Buxton et al., 2017)

Čak su i najzaštićenije lokacije Prikaz zagađenja bukom i njegovog štetnog uticaja dat je u radu autora Barber, Crooks, and Fristrup (2010); Shannon et al. (2016).

Dve trećine Evropljana (Swaddle et al., 2015)

Godine 2003, Hans Slabekorn (Slabbekoorn and Peet, 2003)

Godinu dana kasnije, Henrik Brum (Brumm, 2004)

Te značajne studije podstakle su (Leonard and Horn, 2008; Gross, Pasinelli, and Kunc, 2010; Montague, Danek-Gontard, and Kunc, 2013; Gil et al., 2015)

Svaka dodatna tri decibela (Francis et al., 2017)

Godine 2012, Džesi Barber, Hajdi Ver (Ware et al., 2015)

Tokom jednog eksperimenta, bubamare (Barton et al., 2018)

U bučnoj sredini, prerijski psi (Shannon et al., 2014)

Sove nisu uspešne prilikom napada (Senzaki et al., 2016)

Parazitske muve *Ormia* teško nalaze (Phillips et al., 2019)

Veliki tetrebi napuštaju (Blickley et al., 2012)

U leto (Suraci et al., 2019)
Više od osamdeset tri procenta (Riitters and Wickham, 2003)
Čak ni more ne garantuje tišinu Prikaz prirodne i antropogene buke u okeanima dat je u radu autora Duarte et al. (2021).
War of the Whales (Rat kitova) (Horwitz, 2015)
U svakom slučaju, sonar ih definitivno uznemiruje (DeRuiter et al., 2013; Miller, Kvadsheim, et al., 2015)
U periodu od Drugog svetskog rada do 2008. godine (Frisk, 2012)
Pošto džinovski kitovi žive jedan vek pa i duže (Payne and Webb,)
Dok brodovi plove noću (Rolland et al., 2012; Erbe, Dunlop, and Dolman, 2018; Tsujii et al., 2018; Erbe et al., 2019)
Rakovi ne uzimaju hranu (Kunc et al., 2014; Simpson et al., 2016; Murchy et al., 2019)
„Sprovodimo eksperiment" Dodatno štivo o buci koju proizvode brodovi potražite u delu autora Hildebrand (2005); Malakoff (2010).
Glatke vertikalne površine (Greif et al., 2017)
Dimetil-sulfid, hemikalija koja ima miris morskih algi (Wilcox, Van Sebille, and Hardesty, 2015; Savoca et al., 2016)
struje koje stvaraju plovni objekti (Rycyk et al., 2018)
Mirisi u rekama (Tierney et al., 2008)
Slaba električna polja (Gill et al., 2014)
Neke vrste gradskih noćnih leptira (Altermatt and Ebert, 2016)
Neki gradski paukovi (Czaczkes et al., 2018)
U gradovima u Panami (Halfwerk et al., 2019)
Za tu neobičnu raznovrsnost (Seehausen et al., 2008)
Isključivši svetlost u jezeru (Seehausen, van Alphen, and Witte, 1997)
Poguban uticaj na ciklide iz jezera Viktorija (Witte et al., 2013)
Godine 2020, Maja Kapur (Kapoor, 2020)

U šumama Novog Meksika (Francis et al., 2012)

Godine 2016, morski biolog Tim Gordon (Gordon et al., 2018, 2019)

Žičani kavezi koji se nekad (Irwin, Horner, and Lohmann, 2004)

Pošto je u saobraćaju bilo manje aviona i automobila (Jechow and Hölker, 2020)

Seizmičke vibracije širom sveta (Lecocq et al., 2020)

Zaliv glečera na Aljasci (Calma, 2020; Smith et al., 2020)

Bihevioralna ekološkinja Elizabet Deriberi (Derryberry et al., 2020)

U leto 2007. (Stack et al., 2011)

Da bismo zaista smanjili Prikaz načina za smanjenje zagađenosti čula dat je u radu autora Longcore and Rich (2016); Duarte et al. (2021).

Godine 1995, istoričar životne sredine Vilijam Kronon (Cronon, 1996)

Godine 1934, pošto je proučio (Uexküll, 2010, p. 133)

Bibliografija

Ache, B. W., and Young, J. M. (2005) Olfaction: Diverse species, conserved principles, *Neuron,* 48(3), 417–430.

Ackerman, D. (1991) *A natural history of the senses.* New York: Vintage Books.

Adamo, S. A. (2016) Do insects feel pain? A question at the intersection of animal behaviour, philosophy and robotics, *Animal Behaviour,* 118, 75–79.

Adamo, S. A. (2019) Is it pain if it does not hurt? On the unlikelihood of insect pain, *The Ca- nadian Entomologist,* 151(6), 685–695.

Aflitto, N., and DeGomez, T. (2014) Sonic pest repellents, College of Agriculture, University of Arizona (Tucson, AZ). Available at: repository.arizona.edu/handle/10150/333139.

Agnarsson, I., Kuntner, M., and Blackledge, T. A. (2010) Bioprospecting finds the toughest biological material: Extraordinary silk from a giant riverine orb spider, *PLOS One,* 5(9), e11234.

Albert, J. S., and Crampton, W. G. R. (2006) Electroreception and electrogenesis, in Evans, D. H., and Claiborne, J. B. (eds), *The physiology of fishes,* 3rd ed., 431–472. Boca Raton, FL: CRC Press.

Alexander, R. M. (1996) Hans Werner Lissmann, 30 April 1909–21 April 1995, *Biographical Memoirs of Fellows of the Royal Society,* 42, 235–245.

Altermatt, F., and Ebert, D. (2016) Reduced flight-to-light behaviour of moth populations exposed to long-term urban light pollution, *Biology Letters,* 12(4), 20160111.

Alupay, J. S., Hadjisolomou, S. P., and Crook, R. J. (2014) Arm injury produces long-term behavioral and neural hypersensitivity in octopus, *Neuroscience Letters,* 558, 137–142.

Amey-Özel, M., et al. (2015) More a finger than a nose: The trigeminal motor and sensory in- nervation of the Schnauzenorgan in the elephant-nose fish Gnathonemus petersii, *Journal of Comparative Neurology,* 523(5), 769–789.

Anand, K. J. S., Sippell, W. G., and Aynsley-Green, A. (1987) Randomised trial of fentanyl anaesthesia in preterm babies undergoing surgery: Effects on the stress response, *The Lancet,* 329(8527), 243–248.

Andersson, S., Ornborg, J., and Andersson, M. (1998) Ultraviolet sexual dimorphism and as- sortative mating in blue tits, *Proceedings of the Royal Society B: Biological Sciences,* 265(1395), 445–450.

Andrews, M. T. (2019) Molecular interactions underpinning the phenotype of hibernation in mammals, *Journal of Experimental Biology,* 222(Pt 2), jeb160606.

Appel, M., and Elwood, R. W. (2009) Motivational trade-offs and potential pain experience in hermit crabs, *Applied Animal Behaviour Science,* 119(1), 120–124.

Arch, V. S., and Narins, P. M. (2008) "Silent" signals: Selective forces acting on ultrasonic communication systems in terrestrial vertebrates, *Animal Behaviour,* 76(4), 1423–1428.

Arikawa, K. (2001) Hindsight of butterflies: The *Papilio* butterfly has light sensitivity in the genitalia, which appears to be crucial for reproductive behavior, *BioScience,* 51(3), 219–225.

Arikawa, K. (2017) The eyes and vision of butterflies, *Journal of Physiology,* 595(16), 5457–5464.

Arkley, K., et al. (2014) Strategy change in vibrissal active sensing during rat locomotion, *Cur- rent Biology,* 24(13), 1507–1512.

Arnegard, M. E., and Carlson, B. A. (2005) Electric organ discharge patterns during group hunting by a mormyrid fish, *Proceedings of the Royal Society B: Biological Sciences,* 272(1570), 1305–1314.

Arranz, P., et al. (2011) Following a foraging fish-finder: Diel habitat use of Blainville's beaked whales revealed by echolocation, *PLOS One,* 6(12), e28353.

Aschwanden, C. (2015) Science isn't broken, *FiveThirtyEight.* Available at: fivethirtyeight.com/ features/science-isnt-broken/.

Atema, J. (1971) Structures and functions of the sense of taste in the catfish (*Ictalurus natalis*), *Brain, Behavior and Evolution,* 4(4), 273–294.

Atema, J. (2018) Opening the chemosensory world of the lobster, *Homarus americanus*, *Bulletin of Marine Science,* 94(3), 479–516.

Au, W. W. L. (1993) *The sonar of dolphins.* New York: Springer-Verlag.

Au, W. W. L. (1996) Acoustic reflectivity of a dolphin, *Journal of the Acoustical Society of America,* 99(6), 3844–3848.

Au, W. W. L. (2011) History of dolphin biosonar research, *Acoustics Today,* 11(4), 10–17.

Au, W. W. L., et al. (2009) Acoustic basis for fish prey discrimination by echolocating dolphins and porpoises, *Journal of the Acoustical Society of America,* 126(1), 460–467.

Au, W. W. L., and Simmons, J. A. (2007) Echolocation in dolphins and bats, *Physics Today,* 60(9), 40–45.

Au, W. W., and Turl, C. W. (1983) Target detection in reverberation by an echolocating Atlan- tic bottlenose dolphin

(*Tursiops truncatus*), *Journal of the Acoustical Society of America,* 73(5), 1676–1681.

Audubon, J. J. (1826) Account of the habits of the turkey buzzard (*Vultur aura*), particularly with the view of exploding the opinion generally entertained of its extraordinary power of smelling, *Edinburgh New Philosophical Journal,* 2, 172–184.

Baden, T., Euler, T., and Berens, P. (2020) Understanding the retinal basis of vision across spe- cies, *Nature Reviews Neuroscience,* 21(1), 5–20.

Baker, C. A., and Carlson, B. A. (2019) Electric signals, in Choe, J. C. (ed), *Encyclopedia of animal behavior,* 2nd ed., 474–486. Amsterdam: Elsevier.

Baker, C. A., Huck, K. R., and Carlson, B. A. (2015) Peripheral sensory coding through oscil- latory synchrony in weakly electric fish, *eLife,* 4, e08163.

Baker, C. V. H. (2019) The development and evolution of lateral line electroreceptors: Insights from comparative molecular approaches, in Carlson, B. A., et al. (eds), *Electroreception: Fundamental insights from comparative approaches,* 25–62. Cham: Springer.

Baker, C. V. H., Modrell, M. S., and Gillis, J. A. (2013) The evolution and development of vertebrate lateral line electroreceptors, *Journal of Experimental Biology,* 216(13), 2515–2522.

Baker, R. R. (1980) Goal orientation by blindfolded humans after long-distance displacement: Possible involvement of a magnetic sense, *Science,* 210(4469), 555–557.

Bakken, G. S., et al. (2018) Cooler snakes respond more strongly to infrared stimuli, but we have no idea why, *Journal of Experimental Biology,* 221(17), jeb182121.

Bakken, G. S., and Krochmal, A. R. (2007) The imaging properties and sensitivity of the facial pits of pitvipers as determined by optical and heat-transfer analysis, *Journal of Experimental Biology,* 210(16), 2801–2810.

Baldwin, M. W., et al. (2014) Evolution of sweet taste perception in hummingbirds by trans- formation of the ancestral umami receptor, *Science,* 345(6199), 929–933.

Bálint, A., et al. (2020) Dogs can sense weak thermal radiation, *Scientific Reports,* 10(1), 3736.

Baltzley, M. J., and Nabity, M. W. (2018) Reanalysis of an oft-cited paper on honeybee magnetoreception reveals random behavior, *Journal of Experimental Biology,* 221(Pt 22), jeb185454.

Bang, B. G. (1960) Anatomical evidence for olfactory function in some species of birds, *Nature,* 188(4750), 547–549.

Bang, B. G., and Cobb, S. (1968) The size of the olfactory bulb in 108 species of birds, *The Auk,*
85(1), 55–61.

Barber, J. R., et al. (2015) Moth tails divert bat attack: Evolution of acoustic deflection, *Proceed- ings of the National Academy of Sciences,* 112(9), 2812–2816.

Barber, J. R., and Conner, W. E. (2007) Acoustic mimicry in a predator-prey interaction, *Pro- ceedings of the National Academy of Sciences,* 104(22), 9331–9334.

Barber, J. R., Crooks, K. R., and Fristrup, K. M. (2010) The costs of chronic noise exposure for terrestrial organisms, *Trends in Ecology & Evolution,* 25(3), 180–189.

Barber, J. R., and Kawahara, A. Y. (2013) Hawkmoths produce anti-bat ultrasound, *Biology Letters,* 9(4), 20130161.

Barbero, F., et al. (2009) Queen ants make distinctive sounds that are mimicked by a butterfly social parasite, *Science,* 323(5915), 782–785.

Bargmann, C. I. (2006) Comparative chemosensation from receptors to ecology, *Nature,* 444(7117), 295–301.

Barth, F. G. (2002) *A spider's world: Senses and behavior.* Berlin: Springer. Barth, F. (2015) A spider's tactile hairs, *Scholarpedia,* 10(3), 7267.

Barth, F. G., and Höller, A. (1999) Dynamics of arthropod filiform hairs. V. The response of spider trichobothria to

natural stimuli, *Philosophical Transactions of the Royal Society B: Bio- logical Sciences,* 354(1380), 183–192.

Barton, B. T., et al. (2018) Testing the AC/DC hypothesis: Rock and roll is noise pollution and weakens a trophic cascade, *Ecology and Evolution,* 8(15), 7649–7656.

Basolo, A. L. (1990) Female preference predates the evolution of the sword in swordtail fish, *Science,* 250(4982), 808–810.

Bates, A. E., et al. (2010) Deep-sea hydrothermal vent animals seek cool fluids in a highly vari- able thermal environment, *Nature Communications,* 1(1), 14.

Bates, L. A., et al. (2007) Elephants classify human ethnic groups by odor and garment color, *Current Biology,* 17(22), 1938–1942.

Bates, L. A., et al. (2008) African elephants have expectations about the locations of out-of- sight family members, *Biology Letters,* 4(1), 34–36.

Bateson, P. (1991) Assessment of pain in animals, *Animal Behaviour,* 42(5), 827–839.

Bauer, G. B., et al. (2012) Tactile discrimination of textures by Florida manatees (*Trichechus manatus latirostris*), *Marine Mammal Science,* 28(4), E456–E471.

Bauer, G. B., Reep, R. L., and Marshall, C. D. (2018) The tactile senses of marine mammals, *International Journal of Comparative Psychology,* 31.

Baxi, K. N., Dorries, K. M., and Eisthen, H. L. (2006) Is the vomeronasal system really special- ized for detecting pheromones?, *Trends in Neurosciences,* 29(1), 1–7.

Bedore, C. N., and Kajiura, S. M. (2013) Bioelectric fields of marine organisms: Voltage and frequency contributions to detectability by electroreceptive predators, *Physiological and Biochemical Zoology,* 86(3), 298–311.

Bedore, C. N., Kajiura, S. M., and Johnsen, S. (2015) Freezing behaviour facilitates bioelectric crypsis in cuttlefish faced

with predation risk, *Proceedings of the Royal Society B: Biological Sciences,* 282(1820), 20151886.

Benoit-Bird, K. J., and Au, W. W. L. (2009a) Cooperative prey herding by the pelagic dolphin, *Stenella longirostris, Journal of the Acoustical Society of America,* 125(1), 125–137.

Benoit-Bird, K. J., and Au, W. W. L. (2009b) Phonation behavior of cooperatively foraging spinner dolphins, *Journal of the Acoustical Society of America,* 125(1), 539–546.

Bernal, X. E., Rand, A. S., and Ryan, M. J. (2006) Acoustic preferences and localization per-formance of blood-sucking flies (*Corethrella Coquillett*) to túngara frog calls, *Behavioral Ecol- ogy,* 17(5), 709–715.

Beston, H. (2003) *The outermost house: A year of life on the great beach of Cape Cod.* New York: Holt Paperbacks.

Bianco, G., Ilieva, M., and Åkesson, S. (2019) Magnetic storms disrupt nocturnal migratory activity in songbirds, *Biology Letters,* 15(3), 20180918.

Bingman, V. P., et al. (2017) Importance of the antenniform legs, but not vision, for homing by the neotropical whip spider *Paraphrynus laevifrons, Journal of Experimental Biology,* 220(Pt 5), 885–890.

Birkhead, T. (2013) *Bird sense: What it's like to be a bird.* New York: Bloomsbury.

Bisoffi, Z., et al. (2013) *Strongyloides stercoralis:* A plea for action, *PLOS Neglected Tropical Diseases,* 7(5), e2214.

Bjørge, M. H., et al. (2011) Behavioural changes following intraperitoneal vaccination in At- lantic salmon (*Salmo salar*), *Applied Animal Behaviour Science,* 133(1), 127–135.

Blackledge, T. A., Kuntner, M., and Agnarsson, I. (2011) The form and function of spider orb webs, in Casas, J. (ed), *Advances in insect physiology,* 175–262. Amsterdam: Elsevier.

Blackwall, J. (1830) Mr Murray's paper on the aerial spider, *Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology, and Meteorology,* 2, 116–413.

Blakemore, R. (1975) Magnetotactic bacteria, *Science,* 190(4212), 377–379.

Bleicher, S. S., et al. (2018) Divergent behavior amid convergent evolution: A case of four desert rodents learning to respond to known and novel vipers, *PLOS One,* 13(8), e0200672. Blickley, J. L., et al. (2012) Experimental chronic noise is related to elevated fecal corticosteroid metabolites in lekking male greater sage-grouse (*Centrocercus urophasianus*), *PLOS One,* 7(11), e50462.

Bok, M. J., et al. (2014) Biological sunscreens tune polychromatic ultraviolet vision in mantis shrimp, *Current Biology,* 24(14), 1636–1642.

Bok, M. J., Capa, M., and Nilsson, D.-E. (2016) Here, there and everywhere: The radiolar eyes of fan worms (Annelida, Sabellidae), *Integrative and Comparative Biology,* 56(5), 784–795.

Boles, L. C., and Lohmann, K. J. (2003) True navigation and magnetic maps in spiny lobsters, *Nature,* 421(6918), 60–63.

Bonadonna, F., et al. (2006) Evidence that blue petrel, *Halobaena caerulea,* fledglings can detect and orient to dimethyl sulfide, *Journal of Experimental Biology,* 209(11), 2165–2169.

Boonman, A., et al. (2013) It's not black or white: On the range of vision and echolocation in echolocating bats, *Frontiers in Physiology,* 4, 248.

Boonman, A., Bumrungsri, S., and Yovel, Y. (2014) Nonecholocating fruit bats produce bioso-nar clicks with their wings, *Current Biology,* 24(24), 2962–2967.

Boström, J. E., et al. (2016) Ultra-rapid vision in birds, *PLOS One,* 11(3), e0151099.

Bottesch, M., et al. (2016) A magnetic compass that might help coral reef fish larvae return to their natal reef, *Current Biology,* 26(24), R1266–R1267.

Braithwaite, V. (2010) *Do fish feel pain?* New York: Oxford University Press.

Braithwaite, V., and Droege, P. (2016) Why human pain can't tell us whether fish feel pain, *Animal Sentience,* 3(3).

Braude, S., et al. (2021) Surprisingly long survival of premature conclusions about naked mole- rat biology, *Biological Reviews,* 96(2), 376–393.

Brill, R. L., et al. (1992) Target detection, shape discrimination, and signal characteristics of an echolocating false killer whale (*Pseudorca crassidens*), *Journal of the Acoustical Society of Amer- ica,* 92(3), 1324–1330.

Brinkløv, S., Elemans, C. P. H., and Ratcliffe, J. M. (2017) Oilbirds produce echolocation sig- nals beyond their best hearing range and adjust signal design to natural light conditions, *Royal Society Open Science,* 4(5), 170255.

Brinkløv, S., Fenton, M. B., and Ratcliffe, J. M. (2013) Echolocation in oilbirds and swiftlets,

Frontiers in Physiology, 4, 123.

Brinkløv, S., Kalko, E. K. V., and Surlykke, A. (2009) Intense echolocation calls from two "whispering" bats, *Artibeus jamaicensis* and *Macrophyllum macrophyllum* (Phyllostomidae), *Journal of Experimental Biology,* 212(Pt 1), 11–20.

Brinkløv, S., and Warrant, E. (2017) Oilbirds, *Current Biology,* 27(21), R1145–R1147.

Briscoe, A. D., et al. (2010) Positive selection of a duplicated UV-sensitive visual pigment co- incides with wing pigment evolution in *Heliconius* butterflies, *Proceedings of the National Academy of Sciences,* 107(8), 3628–3633.

Broom, D. (2001) Evolution of pain, *Vlaams Diergeneeskundig Tijdschrift,* 70, 17–21.

Brothers, J. R., and Lohmann, K. J. (2018) Evidence that magnetic navigation and geomagnetic imprinting shape spatial genetic variation in sea turtles, *Current Biology,* 28(8), 1325–1329.e2.

Brown, F. A. (1962) Responses of the planarian, dugesia, and the protozoan, paramecium, to very weak horizontal magnetic fields, *Biological Bulletin,* 123(2), 264–281.

Brown, F. A., Webb, H. M., and Barnwell, F. H. (1964) A compass directional phenomenon in mud-snails and its relation to magnetism, *Biological Bulletin,* 127(2), 206–220.

Brown, R. E., and Fedde, M. R. (1993) Airflow sensors in the avian wing, *Journal of Experimen- tal Biology,* 179(1), 13–30.

Brownell, P., and Farley, R. D. (1979a) Detection of vibrations in sand by tarsal sense organs of the nocturnal scorpion, *Paruroctonus mesaensis, Journal of Comparative Physiology A,* 131(1), 23–30.

Brownell, P., and Farley, R. D. (1979b) Orientation to vibrations in sand by the nocturnal scorpion, *Paruroctonus mesaensis:* Mechanism of target localization, *Journal of Comparative Physiology A,* 131(1), 31–38.

Brownell, P., and Farley, R. D. (1979c) Prey-localizing behaviour of the nocturnal desert scor- pion, *Paruroctonus mesaensis*: Orientation to substrate vibrations, *Animal Behaviour,* 27(Pt 1), 185–193.

Brownell, P. H. (1984) Prey detection by the sand scorpion, *Scientific American,* 251(6), 86–97. Brumm, H. (2004) The impact of environmental noise on song amplitude in a territorial bird,

Journal of Animal Ecology, 73(3), 434–440.

Brunetta, L., and Craig, C. L. (2012) *Spider silk: Evolution and 400 million years of spinning, waiting, snagging, and mating.* New Haven, CT: Yale University Press.

Bryant, A. S., et al. (2018) A critical role for thermosensation in host seeking by skin-penetrating nematodes, *Current Biology,* 28(14), 2338–2347.e6.

Bryant, A. S., and Hallem, E. A. (2018) Temperature-dependent behaviors of parasitic hel-minths, *Neuroscience Letters,* 687, 290–303.

Bullock, T. H. (1969) Species differences in effect of electroreceptor input on electric organ pacemakers and other aspects of behavior in electric fish, *Brain, Behavior and Evolution,* 2(2), 102–118.

Bullock, T. H., Behrend, K., and Heiligenberg, W. (1975) Comparison of the jamming avoid- ance responses in Gymnotoid and Gymnarchid electric fish: A case of convergent evolution of behavior and its sensory basis, *Journal of Comparative Physiology,* 103(1), 97–121.

Bullock, T. H., and Diecke, F. P. J. (1956) Properties of an infra-red receptor, *Journal of Physiol- ogy,* 134(1), 47–87.

Bush, N. E., Solla, S. A., and Hartmann, M. J. (2016) Whisking mechanics and active sensing, *Current Opinion in Neurobiology,* 40, 178–188.

Buxton, R. T., et al. (2017) Noise pollution is pervasive in U.S. protected areas, *Science,* 356(6337), 531–533.

Cadena, V., et al. (2013) Evaporative respiratory cooling augments pit organ thermal detection in rattlesnakes, *Journal of Comparative Physiology A,* 199(12), 1093–1104.

Caldwell, M. S., McDaniel, J. G., and Warkentin, K. M. (2010) Is it safe? Red-eyed treefrog embryos assessing predation risk use two features of rain vibrations to avoid false alarms, *Animal Behaviour,* 79(2), 255–260.

Calma, J. (2020) The pandemic turned the volume down on ocean noise pollution, *The Verge.*

Available at: www.theverge.com/22166314/covid-19-pandemic-ocean-noise-pollution. Caprio, J. (1975) High sensitivity of catfish taste receptors to amino acids, *Comparative Biochemistry and Physiology Part A: Physiology,* 52(1), 247–251.

Caprio, J., et al. (1993) The taste system of the channel catfish: From biophysics to behavior, *Trends in Neurosciences,* 16(5), 192–197.

Caputi, A. A. (2017) Active electroreception in weakly electric fish, in Sherman, S. M. (ed), *Oxford research encyclopedia of*

neuroscience. New York: Oxford University Press. Available at: DOI: 10.1093/acrefore/9780190264086.013.106.

Caputi, A. A., et al. (2013) On the haptic nature of the active electric sense of fish, *Brain Re- search,* 1536, 27–43.

Caputi, Á. A., Aguilera, P. A., and Pereira, A. C. (2011) Active electric imaging: Body-object interplay and object's "electric texture," *PLOS One,* 6(8), e22793.

Caras, M. L. (2013) Estrogenic modulation of auditory processing: A vertebrate comparison, *Frontiers in Neuroendocrinology,* 34(4), 285–299.

Carlson, B. A. (2002) Electric signaling behavior and the mechanisms of electric organ dis- charge production in mormyrid fish, *Journal of Physiology-Paris,* 96(5), 405–419.

Carlson, B. A., et al. (eds), (2019) *Electroreception: Fundamental insights from comparative approaches.* Cham: Springer.

Carlson, B. A., and Arnegard, M. E. (2011) Neural innovations and the diversification of Afri- can weakly electric fishes, *Communicative & Integrative Biology,* 4(6), 720–725.

Carlson, B. A., and Sisneros, J. A. (2019) A brief history of electrogenesis and electroreception in fishes, in Carlson, B. A., et al. (eds), *Electroreception: Fundamental insights from comparative approaches,* 1–23. Cham: Springer.

Caro, T. M. (2016) *Zebra stripes.* Chicago: University of Chicago Press.

Caro, T., et al. (2019) Benefits of zebra stripes: Behaviour of tabanid flies around zebras and horses, *PLOS One,* 14(2), e0210831.

Carpenter, C. W., et al. (2018) Human ability to discriminate surface chemistry by touch, *Ma- terials Horizons,* 5(1), 70–77.

Carr, A. (1995) Notes on the behavioral ecology of sea turtles, in Bjorndal, K. A. (ed), *Biology and conservation of sea turtles,* rev. ed., 19–26. Washington, DC: Smithsonian Institution Press.

Carr, A. L., and Salgado, V. L. (2019) Ticks home in on body heat: A new understanding of Haller's organ and repellent action, *PLOS One,* 14(8), e0221659.

Carr, C. E., and Christensen-Dalsgaard, J. (2015) Sound localization strategies in three predators, *Brain, Behavior and Evolution,* 86(1), 17–27.

Carr, C. E., and Christensen-Dalsgaard, J. (2016) Evolutionary trends in directional hearing, *Current Opinion in Neurobiology,* 40, 111–117.

Carr, T. D., et al. (2017) A new tyrannosaur with evidence for anagenesis and crocodile-like facial sensory system, *Scientific Reports,* 7(1), 44942.

Carrete, M., et al. (2012) Mortality at wind-farms is positively related to large-scale distribution and aggregation in griffon vultures, *Biological Conservation,* 145(1), 102–108.

Carvalho, L. S., et al. (2017) The genetic and evolutionary drives behind primate color vision, *Frontiers in Ecology and Evolution,* 5, 34.

Casas, J., and Dangles, O. (2010) Physical ecology of fluid flow sensing in arthropods, *Annual Review of Entomology,* 55(1), 505–520.

Casas, J., and Steinmann, T. (2014) Predator-induced flow disturbances alert prey, from the onset of an attack, *Proceedings of the Royal Society B: Biological Sciences,* 281(1790), 20141083.

Catania, K. C. (1995a) Magnified cortex in star-nosed moles, *Nature,* 375(6531), 453–454.

Catania, K. C. (1995b) Structure and innervation of the sensory organs on the snout of the star-nosed mole, *Journal of Comparative Neurology,* 351(4), 536–548.

Catania, K. C. (2006) Olfaction: Underwater "sniffing" by semiaquatic mammals, *Nature,* 444(7122), 1024–1025.

Catania, K. C. (2008) Worm grunting, fiddling, and charming—Humans unknowingly mimic a predator to harvest bait, *PLOS One,* 3(10), e3472.

Catania, K. C. (2011) The sense of touch in the star-nosed mole: From mechanoreceptors to the brain, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 366(1581), 3016– 3025.

Catania, K. C. (2016) Leaping eels electrify threats, supporting Humboldt's account of a battle with horses, *Proceedings of the National Academy of Sciences,* 113(25), 6979–6984.

Catania, K. C. (2019) The astonishing behavior of electric eels, *Frontiers in Integrative Neuro- science,* 13, 23.

Catania, K. C., et al. (1993) Nose stars and brain stripes, *Nature,* 364(6437), 493.

Catania, K. C., and Kaas, J. H. (1997a) Somatosensory fovea in the star-nosed mole: Behavioral use of the star in relation to innervation patterns and cortical representation, *Journal of Comparative Neurology,* 387(2), 215–233.

Catania, K. C., and Kaas, J. H. (1997b) The mole nose instructs the brain, *Somatosensory & Motor Research,* 14(1), 56–58.

Catania, K. C., Northcutt, R. G., and Kaas, J. H. (1999) The development of a biological nov- elty: A different way to make appendages as revealed in the snout of the star-nosed mole *Condylura cristata, Journal of Experimental Biology,* 202(Pt 20), 2719–2726.

Catania, K. C., and Remple, F. E. (2004) Tactile foveation in the star-nosed mole, *Brain, Behav- ior and Evolution,* 63(1), 1–12.

Catania, K. C., and Remple, F. E. (2005) Asymptotic prey profitability drives star-nosed moles to the foraging speed limit, *Nature,* 433(7025), 519–522.

Catania, K. C., and Remple, M. S. (2002) Somatosensory cortex dominated by the representation of teeth in the naked mole-rat brain, *Proceedings of the National Academy of Sciences,* 99(8), 5692–5697.

Caves, E. M., Brandley, N. C., and Johnsen, S. (2018) Visual acuity and the evolution of signals, *Trends in Ecology & Evolution,* 33(5), 358–372.

Ceballos, G., Ehrlich, P. R., and Dirzo, R. (2017) Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines, *Proceedings of the National Academy of Sciences,* 114(30), E6089–E6096.

Chappuis, C. J., et al. (2013) Water vapour and heat combine to elicit biting and biting persis- tence in tsetse, *Parasites & Vectors,* 6(1), 240.

Chatigny, F. (2019) The controversy on fish pain: A veterinarian's perspective, *Journal of Applied Animal Welfare Science,* 22(4), 400–410.

Chen, P.-J., et al. (2016) Extreme spectral richness in the eye of the common bluebottle but- terfly, *Graphium sarpedon, Frontiers in Ecology and Evolution,* 4, 12.

Chen, Q., et al. (2012) Reduced performance of prey targeting in pit vipers with contralaterally occluded infrared and visual senses, *PLOS One,* 7(5), e34989.

Chernetsov, N., Kishkinev, D., and Mouritsen, H. (2008) A long-distance avian migrant com- pensates for longitudinal displacement during spring migration, *Current Biology,* 18(3), 188–190.

Chiou, T.-H., et al. (2008) Circular polarization vision in a stomatopod crustacean, *Current Biology,* 18(6), 429–434.

Chiszar, D., et al. (1983) Strike-induced chemosensory searching by rattlesnakes: The role of envenomation-related chemical cues in the post-strike environment, in Müller-Schwarze, D., and Silverstein, R. M. (eds), *Chemical signals in vertebrates,* 3:1–24. Boston: Springer.

Chiszar, D., et al. (1999) Discrimination between envenomated and nonenvenomated prey by western diamondback rattlesnakes (*Crotalus atrox*): Chemosensory consequences of venom, *Copeia,* 1999(3), 640–648.

Chiszar, D., Walters, A., and Smith, H. M. (2008) Rattlesnake preference for envenomated prey: Species specificity, *Journal of Herpetology,* 42(4), 764–767.

Chittka, L. (1997) Bee color vision is optimal for coding flower color, but flower colors are not optimal for being coded—why?, *Israel Journal of Plant Sciences,* 45(2–3), 115–127.

Chittka, L., and Menzel, R. (1992) The evolutionary adaptation of flower colours and the in- sect pollinators' colour vision, *Journal of Comparative Physiology A,* 171(2), 171–181.

Chittka, L., and Niven, J. (2009) Are bigger brains better?, *Current Biology,* 19(21), R995–R1008. Chiu, C., and Moss, C. F. (2008) When echolocating bats do not echolocate, *Communicative &*

Integrative Biology, 1(2), 161–162.

Chiu, C., Xian, W., and Moss, C. F. (2008) Flying in silence: Echolocating bats cease vocaliz- ing to avoid sonar jamming, *Proceedings of the National Academy of Sciences,* 105(35), 13116– 13121.

Chiu, C., Xian, W., and Moss, C. F. (2009) Adaptive echolocation behavior in bats for the analysis of auditory scenes, *Journal of Experimental Biology,* 212(9), 1392–1404.

Cinzano, P., Falchi, F., and Elvidge, C. D. (2001) The first world atlas of the artificial night sky brightness, *Monthly Notices of the Royal Astronomical Society,* 328(3), 689–707.

Clark, C. J., LePiane, K., and Liu, L. (2020) Evolution and ecology of silent flight in owls and other flying vertebrates, *Integrative Organismal Biology,* 2(1), obaa001.

Clark, C. W., and Gagnon, G. C. (2004) Low-frequency vocal behaviors of baleen whales in the North Atlantic: Insights from IUSS detections, locations and tracking from 1992 to 1996, *Journal of Underwater Acoustics,* 52, 609–640.

Clark, G. A., and de Cruz, J. B. (1989) Functional interpretation of protruding filoplumes in oscines, *The Condor,* 91(4), 962–965.

Clark, R. (2004) Timber rattlesnakes (*Crotalus horridus*) use chemical cues to select ambush sites, *Journal of Chemical Ecology,* 30(3), 607–617.

Clark, R., and Ramirez, G. (2011) Rosy boas (*Lichanura trivirgata*) use chemical cues to identify female mice (*Mus musculus*) with litters of dependent young, *Herpetological Journal,* 21(3), 187–191.

Clarke, D., et al. (2013) Detection and learning of floral electric fields by bumblebees, *Science,* 340(6128), 66–69.

Clarke, D., Morley, E., and Robert, D. (2017) The bee, the flower, and the electric field: Elec- tric ecology and aerial electroreception, *Journal of Comparative Physiology A,* 203(9), 737– 748.

Cocroft, R. (1999) Offspring-parent communication in a subsocial treehopper (Hemiptera: Membracidae: *Umbonia crassicornis*), *Behaviour,* 136(1), 1–21.

Cocroft, R. B. (2011) The public world of insect vibrational communication, *Molecular Ecology,* 20(10), 2041–2043.

Cocroft, R. B., and Rodríguez, R. L. (2005) The behavioral ecology of insect vibrational com- munication, *BioScience,* 55(4), 323–334.

Cohen, K. E., et al. (2020) Knowing when to stick: Touch receptors found in the remora adhesive disc, *Royal Society Open Science,* 7(1), 190990.

Cohen, K. L., Seid, M. A., and Warkentin, K. M. (2016) How embryos escape from danger: The mechanism of rapid, plastic hatching in red-eyed treefrogs, *Journal of Experimental Biology,* 219(12), 1875–1883.

Cokl, A., and Virant-Doberlet, M. (2003) Communication with substrate-borne signals in small plant-dwelling insects, *Annual Review of Entomology,* 48, 29–50.

Cole, J. (2016) *Losing touch: A man without his body.* Oxford: Oxford University Press.

Collin, S. P. (2019) Electroreception in vertebrates and invertebrates, in Choe, J. C. (ed), *Ency- clopedia of animal behavior,* 2nd ed., 120–131. Amsterdam: Elsevier.

Collin, S. P., et al. (2009) The evolution of early vertebrate photoreceptors, *Philosophical Trans- actions of the Royal Society B: Biological Sciences,* 364(1531), 2925–2940.

Collins, C. E., Hendrickson, A., and Kaas, J. H. (2005) Overview of the visual system of Tar- sius, *The Anatomical Record: Part A, Discoveries in Molecular, Cellular, and Evolutionary Biology,* 287(1), 1013–1025.

Colour Blind Awareness (n.d.) Living with Colour Vision Deficiency, Colour Blind Aware- ness. Available at: www.colourblindawareness.org/colour-blindness/living-with-colour-vision-deficiency/.

Conner, W. E., and Corcoran, A. J. (2012) Sound strategies: The 65-million-year-old battle between bats and insects, *Annual Review of Entomology,* 57(1), 21–39.

Corbet, S. A., Beament, J., and Eisikowitch, D. (1982) Are electrostatic forces involved in pollen transfer?, *Plant, Cell & Environment,* 5(2), 125–129.

Corcoran, A. J., et al. (2011) How do tiger moths jam bat sonar?, *Journal of Experimental Biology,* 214(14), 2416–2425.

Corcoran, A. J., Barber, J. R., and Conner, W. E. (2009) Tiger moth jams bat sonar, *Science,* 325(5938), 325–327.

Corcoran, A. J., and Moss, C. F. (2017) Sensing in a noisy world: Lessons from auditory spe- cialists, echolocating bats, *Journal of Experimental Biology,* 220(24), 4554–4566.

Corfas, R. A., and Vosshall, L. B. (2015) The cation channel TRPA1 tunes mosquito thermotaxis to host temperatures, *eLife,* 4, e11750.

Costa, D. (1993) The secret life of marine mammals: Novel tools for studying their behavior and biology at sea, *Oceanography,* 6(3), 120–128.

Costa, D., and Kooyman, G. (2011) Oxygen consumption, thermoregulation, and the effect of fur oiling and washing on the sea otter, *Enhydra lutris, Canadian Journal of Zoology,* 60(11), 2761–2767.

Cowart, L. (2021) *Hurts so good: The science and culture of pain on purpose.* New York: Public- Affairs.

Cox, J. J., et al. (2006) An SCN9A channelopathy causes congenital inability to experience pain, *Nature,* 444(7121), 894–898.

Crampton, W. G. R. (2019) Electroreception, electrogenesis and electric signal evolution, *Jour- nal of Fish Biology,* 95(1), 92–134.

Cranford, T. W., Amundin, M., and Norris, K. S. (1996) Functional morphology and homol- ogy in the odontocete nasal complex: Implications for sound generation, *Journal of Mor- phology,* 228(3), 223–285.

Crapse, T. B., and Sommer, M. A. (2008) Corollary discharge across the animal kingdom, *Nature Reviews Neuroscience,* 9(8), 587–600.

Craven, B. A., Paterson, E. G., and Settles, G. S. (2010) The fluid dynamics of canine olfaction: Unique nasal airflow patterns as an explanation of macrosmia, *Journal of the Royal Society Interface,* 7(47), 933–943.

Crish, C., Crish, S., and Comer, C. (2015) Tactile sensing in the naked mole rat, *Scholarpedia,* 10(3), 7164.

Cronin, T. W. (2018) A different view: Sensory drive in the polarized-light realm, *Current Zoology,* 64(4), 513–523.

Cronin, T. W., et al. (2014) *Visual Ecology.* Princeton, NJ: Princeton University Press.

Cronin, T. W., and Bok, M. J. (2016) Photoreception and vision in the ultraviolet, *Journal of Experimental Biology,* 219(18), 2790–2801.

Cronin, T. W., and Marshall, N. J. (1989a) A retina with at least ten spectral types of photore- ceptors in a mantis shrimp, *Nature,* 339(6220), 137–140.

Cronin, T. W., and Marshall, N. J. (1989b) Multiple spectral classes of photoreceptors in the retinas of gonodactyloid

stomatopod crustaceans, *Journal of Comparative Physiology A,* 166(2), 261–275.

Cronin, T. W., Marshall, N. J., and Caldwell, R. L. (2017) Stomatopod vision, in Sherman, S. M. (ed), *Oxford research encyclopedia of neuroscience.* New York: Oxford University Press. Available at: oxfordre.com/neuroscience/view/10.1093/acrefore/9780190264086.001.0001/ acrefore-9780190264086-e-157.

Cronon, W. (1996) The trouble with wilderness; Or, getting back to the wrong nature, *Envi- ronmental History,* 1(1), 7–28.

Crook, R. J. (2021) Behavioral and neurophysiological evidence suggests affective pain experi- ence in octopus, *iScience,* 24(3), 102229.

Crook, R. J., et al. (2011) Peripheral injury induces long-term sensitization of defensive responses to visual and tactile stimuli in the squid *Loligo pealeii,* Lesueur 1821, *Journal of Ex- perimental Biology,* 214(19), 3173–3185.

Crook, R. J., et al. (2014) Nociceptive sensitization reduces predation risk, *Current Biology,* 24(10), 1121–1125.

Crook, R. J., Hanlon, R. T., and Walters, E. T. (2013) Squid have nociceptors that display widespread long-term sensitization and spontaneous activity after bodily injury, *Journal of Neuroscience,* 33(24), 10021–10026.

Crook, R. J., and Walters, E. T. (2014) Neuroethology: Self-recognition helps octopuses avoid entanglement, *Current Biology,* 24(11), R520–R521.

Cross, F. R., et al. (2020) Arthropod intelligence? The case for Portia, *Frontiers in Psychology,* 11.

Crowe-Riddell, J. M., Simões, B. F., et al. (2019) Phototactic tails: Evolution and molecular basis of a novel sensory trait in sea snakes, *Molecular Ecology,* 28(8), 2013–2028.

Crowe-Riddell, J. M., Williams, R., et al. (2019) Ultrastructural evidence of a mechanosensory function of scale organs

(sensilla) in sea snakes (Hydrophiinae), *Royal Society Open Science,* 6(4), 182022.

Cullen, K. E. (2004) Sensory signals during active versus passive movement, *Current Opinion in Neurobiology,* 14(6), 698–706.

Cummings, M. E., Rosenthal, G. G., and Ryan, M. J. (2003) A private ultraviolet channel in visual communication, *Proceedings of the Royal Society B: Biological Sciences,* 270(1518), 897– 904.

Cunningham, S., et al. (2010) Bill morphology of ibises suggests a remote-tactile sensory sys- tem for prey detection, *The Auk,* 127(2), 308–316.

Cunningham, S., Castro, I., and Alley, M. (2007) A new prey-detection mechanism for kiwi (*Apteryx* spp.) suggests convergent evolution between paleognathous and neognathous birds, *Journal of Anatomy,* 211(4), 493–502.

Cunningham, S. J., Alley, M. R., and Castro, I. (2011) Facial bristle feather histology and mor- phology in New Zealand birds: Implications for function, *Journal of Morphology,* 272(1), 118–128.

Cuthill, I. C., et al. (2017) The biology of color, *Science,* 357(6350), eaan0221.

Czaczkes, T. J., et al. (2018) Reduced light avoidance in spiders from populations in light- polluted urban environments, *Naturwissenschaften,* 105(11–12), 64.

Czech-Damal, N. U., et al. (2012) Electroreception in the Guiana dolphin (*Sotalia guianensis*), *Proceedings of the Royal Society B: Biological Sciences,* 279(1729), 663–668.

Czech-Damal, N. U., et al. (2013) Passive electroreception in aquatic mammals, *Journal of Com- parative Physiology A,* 199(6), 555–563.

Daan, S., Barnes, B. M., and Strijkstra, A. M. (1991) Warming up for sleep? Ground squirrels sleep during arousals from hibernation, *Neuroscience Letters,* 128(2), 265–268.

Daly, I., et al. (2016) Dynamic polarization vision in mantis shrimps, *Nature Communications,* 7, 12140.

Daly, I. M., et al. (2018) Complex gaze stabilization in mantis shrimp, *Proceedings of the Royal Society B: Biological Sciences,* 285(1878), 20180594.

Dangles, O., Casas, J., and Coolen, I. (2006) Textbook cricket goes to the field: The ecological scene of the neuroethological play, *Journal of Experimental Biology,* 209(3), 393–398.

Darwin, C. (1871) *The descent of man, and selection in relation to sex.* London: J. Murray.

Darwin, C. (1890) *The formation of vegetable mould, through the action of worms, with observations on their habits*. New York: D. Appleton and Company.

Darwin, C. (1958) *The origin of species by means of natural selection.* New York: Signet.

De Brito Sanchez, M. G., et al. (2014) The tarsal taste of honey bees: Behavioral and electro- physiological analyses, *Frontiers in Behavioral Neuroscience,* 8.

Degen, T., et al. (2016) Street lighting: Sex-independent impacts on moth movement, *Journal of Animal Ecology,* 85(5), 1352–1360.

DeGennaro, M., et al. (2013) *Orco* mutant mosquitoes lose strong preference for humans and are not repelled by volatile DEET, *Nature,* 498(7455), 487–491.

Dehnhardt, G., et al. (2001) Hydrodynamic trail-following in harbor seals (*Phoca vitulina*), *Sci- ence,* 293(5527), 102–104.

Dehnhardt, G., Mauck, B., and Hyvärinen, H. (1998) Ambient temperature does not affect the tactile sensitivity of mystacial vibrissae in harbour seals, *Journal of Experimental Biology,* 201(22), 3023–3029.

Dennis, E. J., Goldman, O. V., and Vosshall, L. B. (2019) *Aedes aegypti* mosquitoes use their legs to sense DEET on contact, *Current Biology,* 29(9), 1551–1556.e5.

Derryberry, E. P., et al. (2020) Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown, *Science,* 370(6516), 575–579.

DeRuiter, S. L., et al. (2013) First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar, *Biology Letters,* 9(4), 20130223.

De Santana, C. D., et al. (2019) Unexpected species diversity in electric eels with a description

of the strongest living bioelectricity generator, *Nature Communications,* 10(1), 4000.

D'Estries, M. (2019) This bat-friendly town turned the night red, *Treehugger.* Available at: www.treehugger.com/worlds-first-bat-friendly-town-turns-night-red-4868381.

D'Ettorre, P. (2016) Genomic and brain expansion provide ants with refined sense of smell, *Proceedings of the National Academy of Sciences,* 113(49), 13947–13949.

Deutschlander, M. E., Borland, S. C., and Phillips, J. B. (1999) Extraocular magnetic compass in newts, *Nature,* 400(6742), 324–325.

Diderot, D. (1749) Lettre sur les aveugles à l'usage de ceux qui voient. Available at: www.google.com/books/edition/Lettre_sur_les_aveugles/W3oHAAAAQAAJ?hl=en&gbpv=1.

Dijkgraaf, S. (1963) The functioning and significance of the lateral-line organs, *Biological Reviews,* 38(1), 51–105.

Dijkgraaf, S. (1989) A short personal review of the history of lateral line research, in Coombs, S., Görner, P., and Münz, H. (eds), *The mechanosensory lateral line,* 7–14. New York: Springer.

Dijkgraaf, S., and Kalmijn, A. J. (1962) Verhaltensversuche zur Funktion der Lorenzinischen Ampullen, *Naturwissenschaften,* 49, 400.

Dinets, V. (2016) No cortex, no cry, *Animal Sentience,* 1(3).

Di Silvestro, R. (2012) Spider-Man vs the real deal: Spider powers, National Wildlife Foun- dation blog. Available at:

blog.nwf.org/2012/06/spiderman-vs-the-real-deal-spider-powers/.

Dominoni, D. M., et al. (2020) Why conservation biology can benefit from sensory ecology, *Nature Ecology & Evolution,* 4(4), 502–511.

Dominy, N. J., and Lucas, P. W. (2001) Ecological importance of trichromatic vision to pri- mates, *Nature,* 410(6826), 363–366.

Dominy, N. J., Svenning, J.-C., and Li, W.-H. (2003) Historical contingency in the evolution of primate color vision, *Journal of Human Evolution,* 44(1), 25–45.

Dooling, R. J., et al. (2002) Auditory temporal resolution in birds: Discrimination of har- monic complexes, *Journal of the Acoustical Society of America,* 112(2), 748–759.

Dooling, R. J., Lohr, B., and Dent, M. L. (2000) Hearing in birds and reptiles, in Dooling, R. J., Fay, R. R., and Popper, A. N. (eds), *Comparative hearing: Birds and reptiles,* 308–359. New York: Springer.

Dooling, R. J., and Prior, N. H. (2017) Do we hear what birds hear in birdsong?, *Animal Behav- iour,* 124, 283–289.

Douglas, R. H., and Jeffery, G. (2014) The spectral transmission of ocular media suggests ultra- violet sensitivity is widespread among mammals, *Proceedings of the Royal Society B: Biological Sciences,* 281(1780), 20132995.

Dreyer, D., et al. (2018) The Earth's magnetic field and visual landmarks steer migratory flight behavior in the nocturnal Australian bogong moth, *Current Biology,* 28(13), 2160–2166.e5.

Du, W.-G., et al. (2011) Behavioral thermoregulation by turtle embryos, *Proceedings of the Na- tional Academy of Sciences,* 108(23), 9513–9515.

Duarte, C. M., et al. (2021) The soundscape of the Anthropocene ocean, *Science,* 371(6529), eaba4658.

Dunlop, R., and Laming, P. (2005) Mechanoreceptive and nociceptive responses in the central nervous system of goldfish (*Carassius auratus*) and trout (*Oncorhynchus mykiss*), *Journal of Pain,* 6(9), 561–568.

Dunning, D. C., and Roeder, K. D. (1965) Moth sounds and the insect-catching behavior of bats, *Science,* 147(3654), 173–174.

Duranton, C., and Horowitz, A. (2019) Let me sniff! Nosework induces positive judgment bias in pet dogs, *Applied Animal Behaviour Science,* 211, 61–66.

Durso, A. (2013) Non-toxic venoms?, *Life is short, but snakes are long* (blog). Available at: snakesarelong.blogspot.com/2013/03/non-toxic-venoms.html.

Dusenbery, D. B. (1992) *Sensory ecology: How organisms acquire and respond to information.* New York: W. H. Freeman.

Dusenbery, M. (2018) *Doing harm: The truth about how bad medicine and lazy science leave women dismissed, misdiagnosed, and sick.* New York: HarperOne.

Eaton, J. (2014) When it comes to smell, the turkey vulture stands (nearly) alone, *Bay Na- ture.* Available at: baynature.org/article/comes-smell-turkey-vulture-stands-nearly-alone/.

Eaton, M. D. (2005) Human vision fails to distinguish widespread sexual dichromatism among sexually "monochromatic" birds, *Proceedings of the National Academy of Sciences,* 102(31), 10942–10946.

Ebert, J., and Westhoff, G. (2006) Behavioural examination of the infrared sensitivity of rattle- snakes (*Crotalus atrox*), *Journal of Comparative Physiology A,* 192(9), 941–947.

Edelman, N. B., et al. (2015) No evidence for intracellular magnetite in putative vertebrate magnetoreceptors identified by magnetic screening, *Proceedings of the National Academy of Sciences,* 112(1), 262–267.

Eder, S. H. K., et al. (2012) Magnetic characterization of isolated candidate vertebrate magne- toreceptor cells, *Proceedings of the National Academy of Sciences,* 109(30), 12022–12027.

Einwich, A., et al. (2020) A novel isoform of cryptochrome 4 (Cry4b) is expressed in the retina of a night-migratory songbird, *Scientific Reports,* 10(1), 15794.

Eisemann, C. H., et al. (1984) Do insects feel pain? A biological view, *Experientia,* 40(2), 164– 167.

Eisenberg, J. F., and Gould, E. (1966) The behavior of *Solenodon paradoxus* in captivity with comments on the behavior of other insectivora, *Zoologica,* 51(4), 49–60.

Eisthen, H. L. (2002) Why are olfactory systems of different animals so similar?, *Brain, Behavior and Evolution,* 59(5–6), 273–293.

Elemans, C. P. H., et al. (2011) Superfast muscles set maximum call rate in echolocating bats, *Science,* 333(6051), 1885–1888.

Elwood, R. W. (2011) Pain and suffering in invertebrates?, *ILAR Journal,* 52(2), 175–184. Elwood, R. W. (2019) Discrimination between nociceptive reflexes and more complex responses consistent with pain in crustaceans, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 374(1785), 20190368.

Elwood, R. W., and Appel, M. (2009) Pain experience in hermit crabs?, *Animal Behaviour,* 77(5), 1243–1246.

Embar, K., et al. (2018) Pit fights: Predators in evolutionarily independent communities, *Jour- nal of Mammalogy,* 99(5), 1183–1188.

Emerling, C. A., and Springer, M. S. (2015) Genomic evidence for rod monochromacy in sloths and armadillos suggests early subterranean history for *Xenarthra, Proceedings of the Royal Society B: Biological Sciences,* 282(1800), 20142192.

Engels, S., et al. (2012) Night-migratory songbirds possess a magnetic compass in both eyes, *PLOS One,* 7(9), e43271.

Engels, S., et al. (2014) Anthropogenic electromagnetic noise disrupts magnetic compass orien- tation in a migratory bird, *Nature,* 509(7500), 353–356.

Erbe, C., et al. (2019) The effects of ship noise on marine mammals—A review, *Frontiers in Marine Science,* 6, 606.

Erbe, C., Dunlop, R., and Dolman, S. (2018) Effects of noise on marine mammals, in Slab- bekoorn, H., et al. (eds), *Effects of anthropogenic noise on animals,* 277–309. New York: Springer.

Eriksson, A., et al. (2012) Exploitation of insect vibrational signals reveals a new method of pest management, *PLOS One,* 7(3), e32954.

Etheredge, J. A., et al. (1999) Monarch butterflies (*Danaus plexippus* L.) use a magnetic compass for navigation, *Proceedings of the National Academy of Sciences,* 96(24), 13845–13846.

European Parliament, Council of the European Union (2010) Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes: Text with EEA relevance, L 276(20. 10.2010), 33–79.

Evans, J. E., et al. (2012) Short-term physiological and behavioural effects of high- versus low- frequency fluorescent light on captive birds, *Animal Behaviour,* 83(1), 25–33.

Falchi, F., et al. (2016) The new world atlas of artificial night sky brightness, *Science Advances,* 2(6), e1600377.

Fedigan, L. M., et al. (2014) The heterozygote superiority hypothesis for polymorphic color vision is not supported by long-term fitness data from wild neotropical monkeys, *PLOS One,* 9(1), e84872.

Feller, K. D., et al. (2021) Surf and turf vision: Patterns and predictors of visual acuity in com- pound eye evolution, *Arthropod Structure & Development,* 60, 101002.

Fenton, M. B., et al. (eds), (2016) *Bat bioacoustics.* New York: Springer.

Fenton, M. B., Faure, P. A., and Ratcliffe, J. M. (2012) Evolution of high duty cycle echoloca- tion in bats, *Journal of Experimental Biology,* 215(17), 2935–2944.

Fertin, A., and Casas, J. (2007) Orientation towards prey in antlions: Efficient use of wave propagation in sand, *Journal of Experimental Biology,* 210(19), 3337–3343.

Feynman, R. (1964) *The Feynman Lectures on Physics,* vol. II, ch. 9, *Electricity in the Atmosphere.*

Available at: www.feynmanlectures.caltech.edu/II_09.html.

Finger, S., and Piccolino, M. (2011) *The shocking history of electric fishes: From ancient epochs to the birth of modern neurophysiology.* New York: Oxford University Press.

Finkbeiner, S. D., et al. (2017) Ultraviolet and yellow reflectance but not fluorescence is impor- tant for visual discrimination of conspecifics by *Heliconius erato, Journal of Experimental Biol- ogy,* 220(7), 1267–1276.

Finneran, J. J. (2013) Dolphin "packet" use during long-range echolocation tasks, *Journal of the Acoustical Society of America,* 133(3), 1796–1810.

Firestein, S. (2005) A Nobel nose: The 2004 Nobel Prize in Physiology and Medicine, *Neuron,* 45(3), 333–338.

Fishbein, A. R., et al. (2020) Sound sequences in birdsong: How much do birds really care?, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 375(1789), 20190044.

Fleissner, G., et al. (2003) Ultrastructural analysis of a putative magnetoreceptor in the beak of homing pigeons, *Journal of Comparative Neurology,* 458(4), 350–360.

Fleissner, G., et al. (2007) A novel concept of Fe-mineral-based magnetoreception: Histological and physicochemical data from the upper beak of homing pigeons, *Naturwissenschaften,* 94(8), 631–642.

Forbes, A. A., et al. (2018) Quantifying the unquantifiable: Why Hymenoptera, not Coleop- tera, is the most speciose animal order, *BMC Ecology,* 18(1), 21.

Ford, N. B., and Low, J. R. (1984) Sex pheromone source location by garter snakes, *Journal of Chemical Ecology,* 10(8), 1193–1199.

Forel, A. (1874) *Les fourmis de la Suisse: Systématique, notices anatomiques et physiologiques, architec- ture, distribution géographique, nouvelles expériences et observations de moeurs.* Zurich: Druck von Zürcher & Furrer.

Fournier, J. P., et al. (2013) If a bird flies in the forest, does an insect hear it?, *Biology Letters,* 9(5), 20130319.

Fox, R., Lehmkuhle, S. W., and Westendorf, D. H. (1976) Falcon visual acuity, *Science,* 192(4236), 263–265.

Francis, C. D., et al. (2012) Noise pollution alters ecological services: Enhanced pollination and disrupted seed dispersal, *Proceedings of the Royal Society B: Biological Sciences,* 279(1739), 2727– 2735.

Francis, C. D., et al. (2017) Acoustic environments matter: Synergistic benefits to humans and ecological communities, *Journal of Environmental Management,* 203(Pt 1), 245–254.

Fransson, T., et al. (2001) Magnetic cues trigger extensive refuelling, *Nature,* 414(6859), 35–36. Friis, I., Sjulstok, E., and Solov'yov, I. A. (2017) Computational reconstruction reveals a candi-date magnetic biocompass to be likely irrelevant for magnetoreception, *Scientific Reports,* 7(1), 13908.

Frisk, G. V. (2012) Noiseonomics: The relationship between ambient noise levels in the sea and global economic trends, *Scientific Reports,* 2(1), 437.

Fritsches, K. A., Brill, R. W., and Warrant, E. J. (2005) Warm eyes provide superior vision in swordfishes, *Current Biology,* 15(1), 55–58.

Fukutomi, M., and Carlson, B. A. (2020) A history of corollary discharge: Contributions of mormyrid weakly electric fish, *Frontiers in Integrative Neuroscience,* 14, 42.

Fullard, J. H., and Yack, J. E. (1993) The evolutionary biology of insect hearing, *Trends in Ecol- ogy & Evolution,* 8(7), 248–252.

Gagliardo, A., et al. (2013) Oceanic navigation in Cory's shearwaters: Evidence for a crucial role of olfactory cues for homing after displacement, *Journal of Experimental Biology,* 216(15), 2798–2805.

Gagnon, Y. L., et al. (2015) Circularly polarized light as a communication signal in mantis shrimps, *Current Biology,* 25(23), 3074–3078.

Gal, R., et al. (2014) Sensory arsenal on the stinger of the parasitoid jewel wasp and its possible role in identifying cockroach brains, *PLOS One,* 9(2), e89683.

Galambos, R., and Griffin, D. R. (1942) Obstacle avoidance by flying bats: The cries of bats, *Journal of Experimental Zoology,* 89(3), 475–490.

Gall, M. D., Salameh, T. S., and Lucas, J. R. (2013) Songbird frequency selectivity and tempo- ral resolution vary with sex and season, *Proceedings of the Royal Society B: Biological Sciences,* 280(1751), 20122296.

Gall, M. D., and Wilczynski, W. (2015) Hearing conspecific vocal signals alters peripheral audi- tory sensitivity, *Proceedings of the Royal Society B: Biological Sciences,* 282(1808), 20150749.

Garcia-Larrea, L., and Bastuji, H. (2018) Pain and consciousness, *Progress in Neuro-Psychopharmacology and Biological Psychiatry,* 87(Pt B), 193–199.

Gardiner, J. M., et al. (2014) Multisensory integration and behavioral plasticity in sharks from different ecological niches, *PLOS One,* 9(4), e93036.

Garm, A., and Nilsson, D.-E. (2014) Visual navigation in starfish: First evidence for the use of vision and eyes in starfish, *Proceedings of the Royal Society B: Biological Sciences,* 281(1777), 20133011.

Garstang, M., et al. (1995) Atmospheric controls on elephant communication, *Journal of Ex- perimental Biology,* 198(Pt 4), 939–951.

Gaspard, J. C., et al. (2017) Detection of hydrodynamic stimuli by the postcranial body of Florida manatees (*Trichechus manatus latirostris*), *Journal of Comparative Physiology A,* 203(2), 111–120.

Gaston, K. J. (2019) Nighttime ecology: The "nocturnal problem" revisited, *The American Naturalist,* 193(4), 481–502.

Gavelis, G. S., et al. (2015) Eye-like ocelloids are built from different endosymbiotically ac- quired components, *Nature,* 523(7559), 204–207.

Gehring, J., Kerlinger, P., and Manville, A. (2009) Communication towers, lights, and birds: Successful methods of reducing the frequency of avian collisions, *Ecological Applications,* 19(2), 505–514.

Gehring, W. J., and Wehner, R. (1995) Heat shock protein synthesis and thermotolerance in *Cataglyphis,* an ant from the Sahara desert, *Proceedings of the National Academy of Sciences,* 92(7), 2994–2998.

Geipel, I., et al. (2019) Bats actively use leaves as specular reflectors to detect acoustically cam- ouflaged prey, *Current Biology,* 29(16), 2731–2736.e3.

Geipel, I., Jung, K., and Kalko, E. K. V. (2013) Perception of silent and motionless prey on vegetation by echolocation in the gleaning bat *Micronycteris microtis, Proceedings of the Royal Society B: Biological Sciences,* 280(1754), 20122830.

Geiser, F. (2013) Hibernation, *Current Biology,* 23(5), R188–R193.

Gentle, M. J., and Breward, J. (1986) The bill tip organ of the chicken (*Gallus gallus* var. *domes- ticus*), *Journal of Anatomy,* 145, 79–85.

Ghose, K., Moss, C. F., and Horiuchi, T. K. (2007) Flying big brown bats emit a beam with two lobes in the vertical plane, *Journal of the Acoustical Society of America,* 122(6), 3717–3724.

Gil, D., et al. (2015) Birds living near airports advance their dawn chorus and reduce overlap with aircraft noise, *Behavioral Ecology,* 26(2), 435–443.

Gill, A. B., et al. (2014) Marine renewable energy, electromagnetic (EM) fields and EM-sensitive animals, in Shields, M. A., and Payne, A. I. L. (eds), *Marine renewable energy technology and environmental interactions,* 61–79. Dordrecht: Springer.

Gläser, N., and Kröger, R. H. H. (2017) Variation in rhinarium temperature indicates sensory specializations in placental mammals, *Journal of Thermal Biology,* 67, 30–34.

Godfrey-Smith, P. (2016) *Other minds: The octopus, the sea, and the deep origins of consciousness.* New York: Farrar, Straus and Giroux.

Goerlitz, H. R., et al. (2010) An aerial-hawking bat uses stealth echolocation to counter moth hearing, *Current Biology,* 20(17), 1568–1572.

Goldberg, Y. P., et al. (2012) Human Mendelian pain disorders: A key to discovery and valida-

tion of novel analgesics, *Clinical Genetics,* 82(4), 367–373.

Goldbogen, J. A., et al. (2019) Extreme bradycardia and tachycardia in the world's largest ani- mal, *Proceedings of the National Academy of Sciences,* 116(50), 25329–25332.

Gol'din, P. (2014) "Antlers inside": Are the skull structures of beaked whales (Cetacea: Ziphi-idae) used for echoic imaging and visual display?, *Biological Journal of the Linnean Society,* 113(2), 510–515.

Goldsmith, T. H. (1980) Hummingbirds see near ultraviolet light, *Science,* 207(4432), 786–788. Gonzalez-Bellido, P. T., Wardill, T. J., and Juusola, M. (2011) Compound eyes and retinal in- formation processing in miniature dipteran species match their specific ecological demands, *Proceedings of the National Academy of Sciences,* 108(10), 4224–4229.

Göpfert, M. C., and Hennig, R. M. (2016) Hearing in insects, *Annual Review of Entomology,* 61, 257–276.

Göpfert, M. C., Surlykke, A., and Wasserthal, L. T. (2002) Tympanal and atympanal "mouth- ears" in hawkmoths (Sphingidae), *Proceedings of the Royal Academy B: Biological Sciences,* 269(1486), 89–95.

Gordon, T. A. C., et al. (2018) Habitat degradation negatively affects auditory settlement be- havior of coral reef fishes, *Proceedings of the National Academy of Sciences,* 115(20), 5193–5198.

Gordon, T. A. C., et al. (2019) Acoustic enrichment can enhance fish community development on degraded coral reef habitat, *Nature Communications,* 10(1), 5414.

Gorham, P. W. (2013) Ballooning spiders: The case for electrostatic flight, arXiv:1309.4731. Goris, R. C. (2011) Infrared organs of snakes: An integral part of vision, *Journal of Herpetology,* 45(1), 2–14.

Goté, J. T., et al. (2019) Growing tiny eyes: How juvenile jumping spiders retain high visual performance in the face of size limitations and developmental constraints, *Vision Research,* 160, 24–36.

Gould, E. (1965) Evidence for echolocation in the Tenrecidae of Madagascar, *Proceedings of the American Philosophical Society,* 109(6), 352–360.

Goutte, S., et al. (2017) Evidence of auditory insensitivity to vocalization frequencies in two frogs, *Scientific Reports,* 7(1), 12121.

Gracheva, E. O., et al. (2010) Molecular basis of infrared detection by snakes, *Nature,* 464(7291), 1006–1011.

Gracheva, E. O., et al. (2011) Ganglion-specific splicing of TRPV1 underlies infrared sensation in vampire bats, *Nature,* 476(7358), 88–91.

Gracheva, E. O., and Bagriantsev, S. N. (2015) Evolutionary adaptation to thermosensation, *Current Opinion in Neurobiology,* 34, 67–73.

Granger, J., et al. (2020) Gray whales strand more often on days with increased levels of atmo- spheric radio-frequency noise, *Current Biology,* 30(4), R155–R156.

Grant, R. A., Breakell, V., and Prescott, T. J. (2018) Whisker touch sensing guides locomotion in small, quadrupedal mammals, *Proceedings of the Royal Society B: Biological Sciences,* 285(1880), 20180592.

Grant, R. A., Sperber, A. L., and Prescott, T. J. (2012) The role of orienting in vibrissal touch sensing, *Frontiers in Behavioral Neuroscience,* 6, 39.

Grasso, F. W. (2014) The octopus with two brains: How are distributed and central representations integrated in the octopus central nervous system?, in Darmaillacq, A.-S., Dickel, L., and Mather, J. (eds), *Cephalopod cognition,* 94–122. Cambridge: Cambridge University Press. Graziadei, P. P., and Gagne, H. T. (1976) Sensory innervation in the rim of the octopus sucker, *Journal of Morphology,* 150(3), 639–679.

Greenwood, V. (2012) The humans with super human vision, *Discover Magazine.* Available at: www.discovermagazine.com/mind/the-humans-with-super-human-vision.

Gregory, J. E., et al. (1989) Responses of electroreceptors in the snout of the echidna, *Journal of Physiology,* 414, 521–538.

Greif, S., et al. (2017) Acoustic mirrors as sensory traps for bats, *Science,* 357(6355), 1045–1047. Griffin, D. R. (1944a) Echolocation by blind men, bats and radar, *Science,* 100(2609),

589–590. Griffin, D. R. (1944b) The sensory basis of bird navigation, *The Quarterly Review of Biology,* 19(1), 15–31.
Griffin, D. R. (1953) Bat sounds under natural conditions, with evidence for echolocation of insect prey, *Journal of Experimental Zoology,* 123(3), 435–465.
Griffin, D. R. (1974) *Listening in the dark: The acoustic orientation of bats and men.* New York: Dover Publications.
Griffin, D. R. (2001) Return to the magic well: Echolocation behavior of bats and responses of insect prey, *BioScience,* 51(7), 555–556.
Griffin, D. R., and Galambos, R. (1941) The sensory basis of obstacle avoidance by flying bats, *Journal of Experimental Zoology,* 86(3), 481–506.
Griffin, D. R., Webster, F. A., and Michael, C. R. (1960) The echolocation of flying insects by bats, *Animal Behaviour,* 8(3), 141–154.
Grinnell, A. D. (1966) Mechanisms of overcoming interference in echolocating animals, in Busnel, R.-G. (ed), *Animal Sonar Systems: Biology and Bionics,* 1, 451–480.
Grinnell, A .D., Gould, E., and Fenton, M. B. (2016) A history of the study of echolocation, in Fenton, M. B., et al. (eds), *Bat bioacoustics,* 1–24. New York: Springer.
Grinnell, A. D., and Griffin, D. R. (1958) The sensitivity of echolocation in bats, *Biological Bul- letin,* 114(1), 10–22.
Gross, K., Pasinelli, G., and Kunc, H. P. (2010) Behavioral plasticity allows short-term adjust- ment to a novel environment, *The American Naturalist,* 176(4), 456–464.
Grüsser, O.-J. (1994) Early concepts on efference copy and reafference, *Behavioral and Brain Sci- ences,* 17(2), 262–265.
Gu, J.-J., et al. (2012) Wing stridulation in a Jurassic katydid (Insecta, Orthoptera) produced low-pitched musical calls to attract females, *Proceedings of the National Academy of Sciences,* 109(10), 3868–3873.

Günther, R. H., O'Connell-Rodwell, C. E., and Klemperer, S. L. (2004) Seismic waves from elephant vocalizations: A possible communication mode?, *Geophysical Research Letters,* 31(11).

Gutnick, T., et al. (2011) *Octopus vulgaris* uses visual information to determine the location of its arm, *Current Biology,* 21(6), 460–462.

Hagedorn, M. (2004) Essay: The lure of field research on electric fish, in von der Emde, G., Mogdans, J., and Kapoor, B. G. (eds), *The senses of fish: Adaptations for the reception of natural stimuli,* 362–368. Dordrecht: Springer.

Hagedorn, M., and Heiligenberg, W. (1985) Court and spark: Electric signals in the courtship and mating of gymnotoid fish, *Animal Behaviour,* 33(1), 254–265.

Hager, F. A., and Kirchner, W. H. (2013) Vibrational long-distance communication in the termites *Macrotermes natalensis* and *Odontotermes* sp., *Journal of Experimental Biology,* 216(17), 3249–3256.

Hager, F. A., and Krausa, K. (2019) Acacia ants respond to plant-borne vibrations caused by mammalian browsers, *Current Biology,* 29(5), 717–725.e3.

Halfwerk, W., et al. (2019) Adaptive changes in sexual signalling in response to urbanization, *Nature Ecology & Evolution,* 3(3), 374–380.

Hamel, J. A., and Cocroft, R. B. (2012) Negative feedback from maternal signals reduces false alarms by collectively signalling offspring, *Proceedings of the Royal Society B: Biological Sci- ences,* 279(1743), 3820–3826.

Han, C. S., and Jablonski, P. G. (2010) Male water striders attract predators to intimidate fe- males into copulation, *Nature Communications,* 1(1), 52.

Hanke, F. D., and Kelber, A. (2020) The eye of the common octopus (*Octopus vulgaris*), *Frontiers in Physiology,* 10, 1637.

Hanke, W., et al. (2010) Harbor seal vibrissa morphology suppresses vortex-induced vibra- tions, *Journal of Experimental Biology,* 213(15), 2665–2672.

Hanke, W., and Dehnhardt, G. (2015) Vibrissal touch in pinnipeds, *Scholarpedia,* 10(3), 6828.

Hanke, W., Römer, R., and Dehnhardt, G. (2006) Visual fields and eye movements in a harbor seal (*Phoca vitulina*), *Vision Research,* 46(17), 2804–2814.

Hardy, A. R., and Hale, M. E. (2020) Sensing the structural characteristics of surfaces: Texture encoding by a bottom-dwelling fish, *Journal of Experimental Biology,* 223(21), jeb227280.

Harley, H. E., Roitblat, H. L., and Nachtigall, P. E. (1996) Object representation in the bottle- nose dolphin (*Tursiops truncatus*): Integration of visual and echoic information, *Journal of Experimental Psychology: Animal Behavior Processes,* 22(2), 164–174.

Hart, N. S., et al. (2011) Microspectrophotometric evidence for cone monochromacy in sharks, *Naturwissenschaften,* 98(3), 193–201.

Hartline, P. H., Kass, L., and Loop, M. S. (1978) Merging of modalities in the optic tectum: Infrared and visual integration in rattlesnakes, *Science,* 199(4334), 1225–1229.

Hartzell, P. L., et al. (2011) Distribution and phylogeny of glacier ice worms (*Mesenchytraeus solifugus* and *Mesenchytraeus solifugus rainierensis*), *Canadian Journal of Zoology,* 83(9), 1206– 1213.

Haspel, G., et al. (2012) By the teeth of their skin, cavefish find their way, *Current Biology,* 22(16), R629–R630.

Haynes, K. F., et al. (2002) Aggressive chemical mimicry of moth pheromones by a bolas spi- der: How does this specialist predator attract more than one species of prey?, *Chemoecol- ogy,* 12(2), 99–105.

Healy, K., et al. (2013) Metabolic rate and body size are linked with perception of temporal information, *Animal Behaviour,* 86(4), 685–696.

Heffner, H. E. (1983) Hearing in large and small dogs: Absolute thresholds and size of the tympanic membrane, *Behavioral Neuroscience,* 97(2), 310–318.

Heffner, H. E., and Heffner, R. S. (2018) The evolution of mammalian hearing, in *To the ear and back again—Advances in auditory biophysics: Proceedings of the 13th Mechanics of Hearing Work- shop,* St. Catharines, Canada, 130001. Available at: aip.scitation.org/doi/abs/10.1063/ 1.5038516.

Heffner, R. S., and Heffner, H. E. (1985) Hearing range of the domestic cat, *Hearing Research,* 19(1), 85–88.

Hein, C. M., et al. (2011) Robins have a magnetic compass in both eyes, *Nature,* 471(7340), E1. Heinrich, B. (1993) *The hot-blooded insects: Strategies and mechanisms of thermoregulation.* Berlin: Springer.

Henninger, J., et al. (2018) Statistics of natural communication signals observed in the wild identify important yet neglected stimulus regimes in weakly electric fish, *Journal of Neuroscience,* 38(24), 5456–5465.

Henry, K. S., et al. (2011) Songbirds tradeoff auditory frequency resolution and temporal reso- lution, *Journal of Comparative Physiology A,* 197(4), 351–359.

Henson, O. W. (1965) The activity and function of the middle-ear muscles in echo-locating

bats, *Journal of Physiology,* 180(4), 871–887.

Hepper, P. G. (1988) The discrimination of human odour by the dog, *Perception,* 17(4), 549–554.

Hepper, P. G., and Wells, D. L. (2005) How many footsteps do dogs need to determine the direction of an odour trail?, *Chemical Senses,* 30(4), 291–298.

Herberstein, M. E., Heiling, A. M., and Cheng, K. (2009) Evidence for UV-based sensory exploitation in Australian but

not European crab spiders, *Evolutionary Ecology,* 23(4), 621– 634.

Heyers, D., et al. (2007) A visual pathway links brain structures active during magnetic com- pass orientation in migratory birds, *PLOS One,* 2(9), e937.

Hildebrand, J. (2005) Impacts of anthropogenic sound, in Reynolds, J. E., et al. (eds), *Marine mammal research: Conservation beyond crisis,* 101–124. Baltimore: Johns Hopkins University Press.

Hill, P. S. M. (2008) *Vibrational communication in animals.* Cambridge, MA: Harvard University Press.

Hill, P. S. M. (2009) How do animals use substrate-borne vibrations as an information source?, *Naturwissenschaften,* 96(12), 1355–1371.

Hill, P. S. M. (2014) Stretching the paradigm or building a new? Development of a cohesive language for vibrational communication, in Cocroft, R. B., et al. (eds), *Studying vibrational communication,* 13–30. Berlin: Springer.

Hill, P. S. M., and Wessel, A. (2016) Biotremology, *Current Biology,* 26(5), R187–R191.

Hines, H. M., et al. (2011) Wing patterning gene redefines the mimetic history of *Heliconius* butterflies, *Proceedings of the National Academy of Sciences,* 108(49), 19666–19671.

Hiramatsu, C., et al. (2017) Experimental evidence that primate trichromacy is well suited for detecting primate social colour signals, *Proceedings of the Royal Society B: Biological Sciences,* 284(1856), 20162458.

Hiryu, S., et al. (2005) Doppler-shift compensation in the Taiwanese leaf-nosed bat (*Hipposide- ros terasensis*) recorded with a telemetry microphone system during flight, *Journal of the Acoustical Society of America,* 118(6), 3927–3933.

Hochner, B. (2012) An embodied view of octopus neurobiology, *Current Biology,* 22(20), R887–R892.

Hochner, B. (2013) How nervous systems evolve in relation to their embodiment: What we can learn from octopuses and other molluscs, *Brain, Behavior and Evolution,* 82(1), 19–30.
Hochstoeger, T., et al. (2020) The biophysical, molecular, and anatomical landscape of pigeon
CRY4: A candidate light-based quantal magnetosensor, *Science Advances,* 6(33), eabb9110. Hofer, B. (1908) Studien über die Hautsinnesorgane der Fische. I. Die Funktion der Seitenor-gane bei den Fischen, *Berichte aus der Kgl. Bayerischen Biologischen Versuchsstation in München,* 1, 115–164.
Hoffstaetter, L. J., Bagriantsev, S. N., and Gracheva, E. O. (2018) TRPs et al.: A molecular toolkit for thermosensory adaptations, *Pflügers Archiv—European Journal of Physiology,* 470(5), 745–759.
Holderied, M. W., and von Helversen, O. (2003) Echolocation range and wingbeat period match in aerial-hawking bats, *Proceedings of the Royal Society B: Biological Sciences,* 270(1530), 2293–2299.
Holland, R. A., et al. (2006) Navigation: Bat orientation using Earth's magnetic field, *Nature,* 444(7120), 702.
Holy, T. E., and Guo, Z. (2005) Ultrasonic songs of male mice, *PLOS Biology,* 3(12), e386.
Hopkins, C., and Bass, A. (1981) Temporal coding of species recognition signals in an electric fish, *Science,* 212(4490), 85–87.
Hopkins, C. D. (1981) On the diversity of electric signals in a community of mormyrid electric fish in West Africa, *American Zoologist,* 21(1), 211–222.
Hopkins, C. D. (2005) Passive electrolocation and the sensory guidance of oriented behavior, in Bullock, T. H., et al. (eds), *Electroreception,* 264–289. New York: Springer.
Hopkins, C. D. (2009) Electrical perception and communication, in Squire, L. R. (ed), *Encyclo- pedia of neuroscience,* 813–831. Amsterdam: Elsevier.

Hore, P. J., and Mouritsen, H. (2016) The radical-pair mechanism of magnetoreception, *An- nual Review of Biophysics,* 45(1), 299–344.

Horowitz, A. (2010) *Inside of a dog: What dogs see, smell, and know*. London: Simon & Schus- ter UK.

Horowitz, A. (2016) *Being a dog: Following the dog into a world of smell.* New York: Scribner.

Horowitz, A., and Franks, B. (2020) What smells? Gauging attention to olfaction in canine cognition research, *Animal Cognition,* 23(1), 11–18.

Horváth, G., et al. (2009) Polarized light pollution: A new kind of ecological photopollution, *Frontiers in Ecology and the Environment,* 7(6), 317–325.

Horwitz, J. (2015) *War of the whales: A true story*. New York: Simon & Schuster.

Hughes, A. (1977) The topography of vision in mammals of contrasting life style: Compara- tive optics and retinal organisation, in Crescitelli, F. (ed), *The visual system in vertebrates,* 613–756. New York: Springer.

Hughes, H. C. (2001) *Sensory exotica: A world beyond human experience*. Cambridge, MA: MIT Press.

Hulgard, K., et al. (2016) Big brown bats (*Eptesicus fuscus*) emit intense search calls and fly in stereotyped flight paths as they forage in the wild, *Journal of Experimental Biology,* 219(3), 334–340.

Hunt, S., et al. (1998) Blue tits are ultraviolet tits, *Proceedings of the Royal Society B: Biological Sci- ences,* 265(1395), 451–455.

Hurst, J., et al. (eds), (2008) *Chemical signals in vertebrates 11*. New York: Springer.

Ibrahim, N., et al. (2014) Semiaquatic adaptations in a giant predatory dinosaur, *Science,* 345(6204), 1613–1616.

Ikinamo (2011) Simroid dental training humanoid robot communicates with trainee dentists #DigInfo. [Video] Available at: www.youtube.com/watch?v=C47NHADFQSo.

Inger, R., et al. (2014) Potential biological and ecological effects of flickering artificial light, *PLOS One,* 9(5), e98631.

Inman, M. (2013) Why the mantis shrimp is my new favorite animal, *The Oatmeal.* Available at: theoatmeal.com/comics/mantis_shrimp.

Irwin, W. P., Horner, A. J., and Lohmann, K. J. (2004) Magnetic field distortions produced by protective cages around sea turtle nests: Unintended consequences for orientation and navigation?, *Biological Conservation,* 118(1), 117–120.

Ivanov, M. P. (2004) Dolphin's echolocation signals in a complicated acoustic environment, *Acoustical Physics,* 50(4), 469–479.

Jacobs, G. H. (1984) Within-species variations in visual capacity among squirrel monkeys (*Sai- miri sciureus*): Color vision, *Vision Research,* 24(10), 1267–1277.

Jacobs, G. H., and Neitz, J. (1987) Inheritance of color vision in a New World monkey (*Saimiri sciureus*), *Proceedings of the National Academy of Sciences,* 84(8), 2545–2549.

Jacobs, G. H., Neitz, J., and Deegan, J. F. (1991) Retinal receptors in rodents maximally sensi- tive to ultraviolet light, *Nature,* 353(6345), 655–656.

Jacobs, L. F. (2012) From chemotaxis to the cognitive map: The function of olfaction, *Proceed- ings of the National Academy of Sciences,* 109(Suppl. 1), 10693–10700.

Jakob, E. M., et al. (2018) Lateral eyes direct principal eyes as jumping spiders track objects, *Current Biology,* 28(18), R1092–R1093.

Jakobsen, L., Ratcliffe, J. M., and Surlykke, A. (2013) Convergent acoustic field of view in echolocating bats, *Nature,* 493(7430), 93–96.

Japyassú, H. F., and Laland, K. N. (2017) Extended spider cognition, *Animal Cognition,* 20(3), 375–395.

Jechow, A., and Hölker, F. (2020) Evidence that reduced air and road traffic decreased artificial night-time skyglow during

COVID-19 lockdown in Berlin, Germany, *Remote Sensing,* 12(20), 3412.

Jiang, P., et al. (2012) Major taste loss in carnivorous mammals, *Proceedings of the National Acad- emy of Sciences,* 109(13), 4956–4961.

Johnsen, S. (2012) *The optics of life: A biologist's guide to light in nature.* Princeton, NJ: Princeton University Press.

Johnsen, S. (2014) Hide and seek in the open sea: Pelagic camouflage and visual countermea- sures, *Annual Review of Marine Science,* 6(1), 369–392.

Johnsen, S. (2017) Open questions: We don't really know anything, do we? Open questions in sensory biology, *BMC Biology,* 15, art. 43.

Johnsen, S., and Lohmann, K. J. (2005) The physics and neurobiology of magnetoreception, *Nature Reviews Neuroscience,* 6(9), 703–712.

Johnsen, S., Lohmann, K. J., and Warrant, E. J. (2020) Animal navigation: A noisy magnetic sense?, *Journal of Experimental Biology,* 223(18), jeb164921.

Johnsen, S., and Widder, E. (2019) Mission logs: June 20, Here be monsters: We filmed a giant

squid in America's backyard, *NOAA Ocean Exploration.* Available at: oceanexplorer.noaa

.gov/explorations/19biolum/logs/jun20/jun20.html.

Johnson, M., et al. (2004) Beaked whales echolocate on prey, *Proceedings of the Royal Society B: Biological Sciences,* 271(Suppl. 6), S383–S386.

Johnson, M., Aguilar de Soto, N., and Madsen, P. (2009) Studying the behaviour and sensory ecology of marine mammals using acoustic recording tags: A review, *Marine Ecology Prog- ress Series,* 395, 55–73.

Johnson, R. N., et al. (2018) Adaptation and conservation insights from the koala genome, *Nature Genetics,* 50(8), 1102–1111.

Jones, G., and Teeling, E. (2006) The evolution of echolocation in bats, *Trends in Ecology & Evolution,* 21(3), 149–156.

Jordan, G., et al. (2010) The dimensionality of color vision in carriers of anomalous trichro- macy, *Journal of Vision,* 10(8), 12.

Jordan, G., and Mollon, J. (2019) Tetrachromacy: The mysterious case of extra-ordinary color vision, *Current Opinion in Behavioral Sciences,* 30, 130–134.

Jordt, S.-E., and Julius, D. (2002) Molecular basis for species-specific sensitivity to "hot" chili peppers, *Cell,* 108(3), 421–430.

Josberger, E. E., et al. (2016) Proton conductivity in ampullae of Lorenzini jelly, *Science Ad- vances,* 2(5), e1600112.

Jung, J., et al. (2019) How do red-eyed treefrog embryos sense motion in predator attacks? As- sessing the role of vestibular mechanoreception, *Journal of Experimental Biology,* 222(21), jeb206052.

Jung, K., Kalko, E. K. V., and von Helversen, O. (2007) Echolocation calls in Central Ameri- can emballonurid bats: Signal design and call frequency alternation, *Journal of Zoology,* 272(2), 125–137.

Kajiura, S. M. (2001) Head morphology and electrosensory pore distribution of carcharhinid and sphyrnid sharks, *Environmental Biology of Fishes,* 61(2), 125–133.

Kajiura, S. M. (2003) Electroreception in neonatal bonnethead sharks, *Sphyrna tiburo, Marine Biology,* 143(3), 603–611.

Kajiura, S. M., and Holland, K. N. (2002) Electroreception in juvenile scalloped hammerhead and sandbar sharks, *Journal of Experimental Biology,* 205(23), 3609–3621.

Kalberer, N. M., Reisenman, C. E., and Hildebrand, J. G. (2010) Male moths bearing transplanted female antennae express characteristically female behaviour and central neural activity, *Journal of Experimental Biology,* 213(8), 1272–1280.

Kalka, M. B., Smith, A. R., and Kalko, E. K. V. (2008) Bats limit arthropods and herbivory in a tropical forest, *Science,* 320(5872), 71.

Kalmijn, A. J. (1971) The electric sense of sharks and rays, *Journal of Experimental Biology,* 55(2), 371–383.

Kalmijn, A. J. (1974) The detection of electric fields from inanimate and animate sources other than electric organs, in Fessard, A. (ed), *Electroreceptors and other specialized receptors in lower vertebrates,* 147–200. Berlin: Springer.

Kalmijn, A. J. (1982) Electric and magnetic field detection in elasmobranch fishes, *Science,* 218(4575), 916–918.

Kaminski, J., et al. (2019) Evolution of facial muscle anatomy in dogs, *Proceedings of the National Academy of Sciences,* 116(29), 14677–14681.

Kane, S. A., Van Beveren, D., and Dakin, R. (2018) Biomechanics of the peafowl's crest reveals frequencies tuned to social displays, *PLOS One,* 13(11), e0207247.

Kant, I. (2007) *Anthropology, history, and education.* Cambridge: Cambridge University Press. Kapoor, M. (2020) The only catfish native to the western U.S. is running out of water, *High*

Country News. Available at: www.hcn.org/issues/52.7/fish-the-only-catfish-native-to-the-western-u-s-is-running-out-of-water.

Kardong, K. V., and Berkhoudt, H. (1999) Rattlesnake hunting behavior: Correlations be- tween plasticity of predatory performance and neuroanatomy, *Brain, Behavior and Evolu- tion,* 53(1), 20–28.

Kardong, K. V., and Mackessy, S. P. (1991) The strike behavior of a congenitally blind rattle- snake, *Journal of Herpetology,* 25(2), 208–211.

Kasumyan, A. O. (2019) The taste system in fishes and the effects of environmental variables, *Journal of Fish Biology,* 95(1), 155–178.

Katz, H. K., et al. (2015) Eye movements in chameleons are not truly independent—Evidence from simultaneous monocular tracking of two targets, *Journal of Experimental Biology,* 218(13), 2097–2105.

Kavaliers, M. (1988) Evolutionary and comparative aspects of nociception, *Brain Research Bul- letin,* 21(6), 923–931.

Kawahara, A. Y., et al. (2019) Phylogenomics reveals the evolutionary timing and pattern of butterflies and moths, *Proceedings of the National Academy of Sciences,* 116(45), 22657–22663. Kelber, A., Balkenius, A., and Warrant, E. J. (2002) Scotopic colour vision in nocturnal hawk-moths, *Nature,* 419(6910), 922–925.

Kelber, A., Vorobyev, M., and Osorio, D. (2003) Animal colour vision—Behavioural tests and physiological concepts, *Biological Reviews of the Cambridge Philosophical Society,* 78(1), 81–118. Keller, A., et al. (2007) Genetic variation in a human odorant receptor alters odour perception, *Nature,* 449(7161), 468–472.

Keller, A., and Vosshall, L. B. (2004a) A psychophysical test of the vibration theory of olfac- tion, *Nature Neuroscience,* 7(4), 337–338.

Keller, A., and Vosshall, L. B. (2004b) Human olfactory psychophysics, *Current Biology,* 14(20), R875–R878.

Kempster, R. M., Hart, N. S., and Collin, S. P. (2013) Survival of the stillest: Predator avoid- ance in shark embryos, *PLOS One,* 8(1), e52551.

Ketten, D. R. (1997) Structure and function in whale ears, *Bioacoustics,* 8(1–2), 103–135. Key, B. (2016) Why fish do not feel pain, *Animal Sentience,* 1(3).

Key, F. M., et al. (2018) Human local adaptation of the TRPM8 cold receptor along a latitudi- nal cline, *PLOS Genetics,* 14(5), e1007298.

Kick, S., and Simmons, J. (1984) Automatic gain control in the bat's sonar receiver and the neuroethology of echolocation, *Journal of Neuroscience,* 4(11), 2725–2737.

Kimchi, T., Etienne, A. S., and Terkel, J. (2004) A subterranean mammal uses the magnetic compass for path integration, *Proceedings of the National Academy of Sciences,* 101(4), 1105– 1109.

King, J. E., Becker, R. F., and Markee, J. E. (1964) Studies on olfactory discrimination in dogs: (3) Ability to detect human odour trace, *Animal Behaviour,* 12(2), 311–315.

Kingston, A. C. N., et al. (2015) Visual phototransduction components in cephalopod chro- matophores suggest dermal photoreception, *Journal of Experimental Biology,* 218(10), 1596– 1602.

Kirschfeld, K. (1976) The resolution of lens and compound eyes, in Zettler, F., and Weiler, R. (eds), *Neural principles in vision,* 354–370. Berlin: Springer.

Kirschvink, J., et al. (1997) Measurement of the threshold sensitivity of honeybees to weak, ex- tremely low-frequency magnetic fields, *Journal of Experimental Biology,* 200(Pt 9), 1363–1368.

Kish, D. (1995) Echolocation: How humans can "see" without sight. Unpublished master's thesis, California State University.

Kish, D. (2015) How I use sonar to navigate the world. TED Talk. Available at: www.ted.com/talks/daniel_kish_how_i_use_sonar_to_navigate_the_world.

Klärner, D., and Barth, F. G. (1982) Vibratory signals and prey capture in orb-weaving spiders (*Zygiella x-notata, Nephila clavipes;* Araneidae), *Journal of Comparative Physiology,* 148(4), 445– 455.

Klopsch, C., Kuhlmann, H. C., and Barth, F. G. (2012) Airflow elicits a spider's jump towards airborne prey. I. Airflow around a flying blowfly, *Journal of the Royal Society Interface,* 9(75), 2591–2602.

Klopsch, C., Kuhlmann, H. C., and Barth, F. G. (2013) Airflow elicits a spider's jump towards airborne prey. II. Flow

characteristics guiding behaviour, *Journal of the Royal Society Inter- face,* 10(82), 20120820.
Knop, E., et al. (2017) Artificial light at night as a new threat to pollination, *Nature,* 548(7666), 206–209.
Knudsen, E. I., Blasdel, G. G., and Konishi, M. (1979) Sound localization by the barn owl (*Tyto alba*) measured with the search coil technique, *Journal of Comparative Physiology A,* 133(1), 1–11.
Kober, R., and Schnitzler, H. (1990) Information in sonar echoes of fluttering insects available for echolocating bats, *Journal of the Acoustical Society of America,* 87(2), 882–896.
Kojima, S. (1990) Comparison of auditory functions in the chimpanzee and human, *Folia Pri- matologica,* 55(2), 62–72.
Kolbert, E. (2014) *The sixth extinction: An unnatural history.* New York: Henry Holt.
Konishi, M. (1969) Time resolution by single auditory neurones in birds, *Nature,* 222(5193), 566–567.
Konishi, M. (1973) Locatable and nonlocatable acoustic signals for barn owls, *The American Naturalist,* 107(958), 775–785.
Konishi, M. (2012) How the owl tracks its prey, *American Scientist,* 100(6), 494.
Koselj, K., Schnitzler, H.-U., and Siemers, B. M. (2011) Horseshoe bats make adaptive prey- selection decisions, informed by echo cues, *Proceedings of the Royal Society B: Biological Sci- ences,* 278(1721), 3034–3041.
Koshitaka, H., et al. (2008) Tetrachromacy in a butterfly that has eight varieties of spectral re- ceptors, *Proceedings of the Royal Society B: Biological Sciences,* 275(1637), 947–954.
Kothari, N. B., et al. (2014) Timing matters: Sonar call groups facilitate target localization in bats, *Frontiers in Physiology,* 5, 168.
Krestel, D., et al. (1984) Behavioral determination of olfactory thresholds to amyl acetate in dogs, *Neuroscience and Biobehavioral Reviews,* 8(2), 169–174.

Kröger, R. H. H., and Goiricelaya, A. B. (2017) Rhinarium temperature dynamics in domestic dogs, *Journal of Thermal Biology,* 70, 15–19.

Krumm, B., et al. (2017) Barn owls have ageless ears, *Proceedings of the Royal Society B: Biological Sciences,* 284(1863), 20171584.

Kuhn, R. A., et al. (2010) Hair density in the Eurasian otter *Lutra lutra* and the sea otter *Enhydra lutris, Acta Theriologica,* 55(3), 211–222.

Kuna, V. M., and Nábělek, J. L. (2021) Seismic crustal imaging using fin whale songs, *Science,* 371(6530), 731–735.

Kunc, H., et al. (2014) Anthropogenic noise affects behavior across sensory modalities, *The American Naturalist,* 184 (4), E93–E100.

Kürten, L., and Schmidt, U. (1982) Thermoperception in the common vampire bat (*Desmodus rotundus*), *Journal of Comparative Physiology A,* 146(2), 223–228.

Kwon, D. (2019) Watcher of whales: A profile of Roger Payne. *The Scientist.* Available at: www.the-scientist.com/profile/watcher-of-whales--a-profile-of-roger-payne-66610.

Kyba, C. C. M., et al. (2017) Artificially lit surface of Earth at night increasing in radiance and extent, *Science Advances,* 3(11), e1701528.

Land, M. F. (1966) A multilayer interference reflector in the eye of the scallop, *Pecten maximus, Journal of Experimental Biology,* 45(3), 433–447.

Land, M. F. (1969a) Movements of the retinae of jumping spiders (Salticidae: Dendryphan- tinae) in response to visual stimuli, *Journal of Experimental Biology,* 51(2), 471–493.

Land, M. F. (1969b) Structure of the retinae of the principal eyes of jumping spiders (Salticidae: Dendryphantinae) in relation to visual optics, *Journal of Experimental Biology,* 51(2), 443–470.

Land, M. F. (2003) The spatial resolution of the pinhole eyes of giant clams (*Tridacna maxima*), *Proceedings of the Royal Society B: Biological Sciences,* 270(1511), 185–188.

Land, M. F. (2018) *Eyes to see: The astonishing variety of vision in nature.* Oxford: Oxford Univer- sity Press.

Land, M. F., et al. (1990) The eye-movements of the mantis shrimp *Odontodactylus scyllarus* (Crustacea: Stomatopoda), *Journal of Comparative Physiology A,* 167(2), 155–166.

Landler, L., et al. (2018) Comment on "Magnetosensitive neurons mediate geomagnetic orien- tation in *Caenorhabditis elegans,*" *eLife,* 7, e30187.

Landolfa, M. A., and Barth, F. G. (1996) Vibrations in the orb web of the spider *Nephila clavipes*: Cues for discrimination and orientation, *Journal of Comparative Physiology A,* 179(4), 493– 508.

Lane, K. A., Lucas, K. M., and Yack, J. E. (2008) Hearing in a diurnal, mute butterfly, *Morpho peleides* (Papilionoidea, Nymphalidae), *Journal of Comparative Neurology,* 508(5), 677–686.

Laska, M. (2017) Human and animal olfactory capabilities compared, in Buettner, A. (ed), *Springer handbook of odor,* 81–82. New York: Springer.

Laughlin, S. B., and Weckström, M. (1993) Fast and slow photoreceptors—A comparative study of the functional diversity of coding and conductances in the Diptera, *Journal of Comparative Physiology A,* 172(5), 593–609.

Laursen, W. J., et al. (2016) Low-cost functional plasticity of TRPV1 supports heat tolerance in squirrels and camels, *Proceedings of the National Academy of Sciences,* 113(40), 11342–11347.

LaVinka, P. C., and Park, T. J. (2012) Blunted behavioral and C Fos responses to acidic fumes in the African naked mole-rat, *PLOS One,* 7(9), e45060.

Lavoué, S., et al. (2012) Comparable ages for the independent origins of electrogenesis in Afri- can and South American weakly electric fishes, *PLOS One,* 7(5), e36287.

Lawson, S. L., et al. (2018) Relative salience of syllable structure and syllable order in zebra finch song, *Animal Cognition,* 21(4), 467–480.

Lazzari, C. R. (2009) Orientation towards hosts in haematophagous insects, in Simpson, S., and Casas, J. (eds), *Advances in insect physiology,* vol. 37, 1–58. Amsterdam: Elsevier.

Lecocq, T., et al. (2020) Global quieting of high-frequency seismic noise due to COVID-19 pandemic lockdown measures, *Science,* 369(6509), 1338–1343.

Lee-Johnson, C. P., and Carnegie, D. A. (2010) Mobile robot navigation modulated by artificial emotions, *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics),* 40(2), 469–480.

Legendre, F., Marting, P. R., and Cocroft, R. B. (2012) Competitive masking of vibrational signals during mate searching in a treehopper, *Animal Behaviour,* 83(2), 361–368.

Leitch, D. B., and Catania, K. C. (2012) Structure, innervation and response properties of integumentary sensory organs in crocodilians, *Journal of Experimental Biology,* 215(23), 4217– 4230.

Lenoir, A., et al. (2001) Chemical ecology and social parasitism in ants, *Annual Review of Ento- mology,* 46(1), 573–599.

Leonard, M. L., and Horn, A. G. (2008) Does ambient noise affect growth and begging call structure in nestling birds?, *Behavioral Ecology,* 19(3), 502–507.

Leonhardt, S. D., et al. (2016) Ecology and evolution of communication in social insects, *Cell,* 164(6), 1277–1287.

Levy, G., and Hochner, B. (2017) Embodied organization of *Octopus vulgaris* morphology, vi- sion, and locomotion, *Frontiers in Physiology,* 8, 164.

Lewin, G., Lu, Y., and Park, T. (2004) A plethora of painful molecules, *Current Opinion in Neurobiology,* 14(4), 443–449.

Lewis, E. R., et al. (2006) Preliminary evidence for the use of microseismic cues for navigation by the Namib golden mole, *Journal of the Acoustical Society of America,* 119(2), 1260–1268.

Lewis, J. (2014) Active electroreception: Signals, sensing, and behavior, in Evans, D. H., Claiborne, J. B., and Currie, S. (eds), *The physiology of fishes,* 4th ed., 373–388. Boca Raton, FL: CRC Press.

Li, F. (2013) Taste perception: From the tongue to the testis, *Molecular Human Reproduction,* 19(6), 349–360.

Li, L., et al. (2015) Multifunctionality of chiton biomineralized armor with an integrated visual system, *Science,* 350(6263), 952–956.

Lind, O., et al. (2013) Ultraviolet sensitivity and colour vision in raptor foraging, *Journal of Experimental Biology,* 216(Pt 10), 1819–1826.

Linsley, E. G. (1943) Attraction of *Melanophila* beetles by fire and smoke, *Journal of Economic Entomology,* 36(2), 341–342.

Linsley, E. G., and Hurd, P. D. (1957) *Melanophila* beetles at cement plants in Southern Califor- nia (Coleoptera, Buprestidae), *Coleopterists Bulletin,* 11(1/2), 9–11.

Lissmann, H. W. (1951) Continuous electrical signals from the tail of a fish, *Gymnarchus niloticus*

Cuv., *Nature,* 167(4240), 201–202.

Lissmann, H. W. (1958) On the function and evolution of electric organs in fish, *Journal of Experimental Biology,* 35(1), 156–191.

Lissmann, H. W., and Machin, K. E. (1958) The mechanism of object location in *Gymnarchus niloticus* and similar fish, *Journal of Experimental Biology,* 35(2), 451–486.

Liu, M. Z., and Vosshall, L. B. (2019) General visual and contingent thermal cues interact to elicit attraction in female *Aedes aegypti* mosquitoes, *Current Biology*, 29(13), 2250–2257.e4.

Liu, Z., et al. (2014) Repeated functional convergent effects of NaV1.7 on acid insensitivity in hibernating mammals, *Proceedings of the Royal Society B: Biological Sciences,* 281(1776), 20132950.

Lloyd, E., et al. (2018) Evolutionary shift towards lateral line dependent prey capture behavior in the blind Mexican cavefish, *Developmental Biology,* 441(2), 328–337.

Lohmann, K. J. (1991) Magnetic orientation by hatchling loggerhead sea turtles (*Caretta caretta*), *Journal of Experimental Biology,* 155, 37–49.

Lohmann, K., et al. (1995) Magnetic orientation of spiny lobsters in the ocean: Experiments with undersea coil systems, *Journal of Experimental Biology,* 198(Pt 10), 2041–2048.

Lohmann, K. J., et al. (2001) Regional magnetic fields as navigational markers for sea turtles, *Science,* 294(5541), 364–366.

Lohmann, K. J., et al. (2004) Geomagnetic map used in seaturtle navigation, *Nature,* 428(6986), 909–910.

Lohmann, K., and Lohmann, C. (1994) Detection of magnetic inclination angle by sea turtles: A possible mechanism for determining latitude, *Journal of Experimental Biology,* 194(1), 23–32.

Lohmann, K. J., and Lohmann, C. M. F. (1996) Detection of magnetic field intensity by sea turtles, *Nature,* 380(6569), 59–61.

Lohmann, K. J., and Lohmann, C. M. F. (2019) There and back again: Natal homing by magnetic navigation in sea turtles and salmon, *Journal of Experimental Biology,* 222(Suppl. 1), jeb184077.

Lohmann, K. J., Putman, N. F., and Lohmann, C. M. F. (2008) Geomagnetic imprinting: A unifying hypothesis

of long-distance natal homing in salmon and sea turtles, *Proceedings of the National Academy of Sciences,* 105(49), 19096–19101.

Longcore, T. (2018) Hazard or hope? LEDs and wildlife, *LED Professional Review,* 70, 52–57.

Longcore, T., et al. (2012) An estimate of avian mortality at communication towers in the United States and Canada, *PLOS One,* 7(4), e34025.

Longcore, T., and Rich, C. (2016) *Artificial night lighting and protected lands: Ecological effects and management approaches.* Natural Resource Report 2017/1493.

Lu, P., et al. (2017) Extraoral bitter taste receptors in health and disease, *Journal of General Phys- iology,* 149(2), 181–197.

Lubbock, J. (1881) Observations on ants, bees, and wasps.—Part VIII, *Journal of the Linnean Society of London, Zoology,* 15(87), 362–387.

Lucas, J., et al. (2002) A comparative study of avian auditory brainstem responses: Correlations with phylogeny and vocal complexity, and seasonal effects, *Journal of Comparative Physiol- ogy A,* 188(11–12), 981–992.

Lucas, J. R., et al. (2007) Seasonal variation in avian auditory evoked responses to tones: A comparative analysis of Carolina chickadees, tufted titmice, and white-breasted nut- hatches, *Journal of Comparative Physiology A,* 193(2), 201–215.

Ludeman, D. A., et al. (2014) Evolutionary origins of sensation in metazoans: Functional evidence for a new sensory organ in sponges, *BMC Evolutionary Biology,* 14(1), 3.

Maan, M. E., and Cummings, M. E. (2012) Poison frog colors are honest signals of toxicity, particularly for bird predators, *The American Naturalist,* 179(1), E1–E14.

Macpherson, F. (2011) Individuating the senses, in Macpherson, F. (ed), *The senses: Classic and contemporary philosophical perspectives,* 3–43. Oxford: Oxford University Press.

Madhav, M. S., et al. (2018) High-resolution behavioral mapping of electric fishes in Amazo- nian habitats, *Scientific Reports,* 8(1), 5830.

Madsen, P. T., et al. (2002) Sperm whale sound production studied with ultrasound time/depth-recording tags, *Journal of Experimental Biology,* 205(Pt 13), 1899–1906.

Madsen, P. T., et al. (2013) Echolocation in Blainville's beaked whales (*Mesoplodon densirostris*), *Journal of Comparative Physiology A,* 199(6), 451–469.

Madsen, P. T., and Surlykke, A. (2014) Echolocation in air and water, in Surlykke, A., et al. (eds), *Biosonar,* 257–304. New York: Springer.

Majid, A. (2015) Cultural factors shape olfactory language, *Trends in Cognitive Sciences,* 19(11), 629–630.

Majid, A., et al. (2017) What makes a better smeller?, *Perception,* 46(3–4), 406–430.

Majid, A., and Kruspe, N. (2018) Hunter-gatherer olfaction is special, *Current Biology,* 28(3), 409–413.e2.

Malakoff, D. (2010) A push for quieter ships, *Science,* 328(5985), 1502–1503.

Mancuso, K., et al. (2009) Gene therapy for red-green colour blindness in adult primates, *Na- ture,* 461(7625), 784–787.

Marder, E., and Bucher, D. (2007) Understanding circuit dynamics using the stomatogastric nervous system of lobsters and crabs, *Annual Review of Physiology,* 69(1), 291–316.

Marshall, C. D., et al. (1998) Prehensile use of perioral bristles during feeding and associated behaviors of the Florida manatee (*Trichechus manatus latirostris*), *Marine Mammal Science,* 14(2), 274–289.

Marshall, C. D., Clark, L. A., and Reep, R. L. (1998) The muscular hydrostat of the Florida manatee (*Trichechus manatus latirostris*): A functional morphological model of perioral bris- tle use, *Marine Mammal Science,* 14(2), 290–303.

Marshall, J., and Arikawa, K. (2014) Unconventional colour vision, *Current Biology,* 24(24), R1150–R1154.

Marshall, J., Carleton, K. L., and Cronin, T. (2015) Colour vision in marine organisms, *Current Opinions in Neurobiology,* 34, 86–94.

Marshall, J., and Oberwinkler, J. (1999) The colourful world of the mantis shrimp, *Nature,* 401(6756), 873–874.

Marshall, N. J. (1988) A unique colour and polarization vision system in mantis shrimps, *Na- ture,* 333(6173), 557–560.

Marshall, N. J., et al. (2019a) Colours and colour vision in reef fishes: Past, present and future research directions, *Journal of Fish Biology,* 95(1), 5–38.

Marshall, N. J., et al. (2019b) Polarisation signals: A new currency for communication, *Journal of Experimental Biology,* 222(3), jeb134213.

Marshall, N. J., Land, M. F., and Cronin, T. W. (2014) Shrimps that pay attention: Saccadic eye movements in stomatopod crustaceans, *Philosophical Transactions of the Royal Society B: Bio- logical Sciences,* 369(1636), 20130042.

Martin, G. R. (2012) Through birds' eyes: Insights into avian sensory ecology, *Journal of Orni- thology,* 153(Suppl. 1), 23–48.

Martin, G. R., Portugal, S. J., and Murn, C. P. (2012) Visual fields, foraging and collision vul- nerability in *Gyps* vultures, *Ibis,* 154(3), 626–631.

Martinez, V., et al. (2020) Antlions are sensitive to subnanometer amplitude vibrations carried by sand substrates, *Journal of Comparative Physiology A,* 206(5), 783–791.

Masland, R. H. (2017) Vision: Two speeds in the retina, *Current Biology,* 27(8), R303–R305.

Mason, A. C., Oshinsky, M. L., and Hoy, R. R. (2001) Hyperacute directional hearing in a microscale auditory system, *Nature,* 410(6829), 686–690.

Mason, M. J. (2003) Bone conduction and seismic sensitivity in golden moles (Chrysochloridae), *Journal of Zoology,* 260(4), 405–413.

Mason, M. J., and Narins, P. M. (2002) Seismic sensitivity in the desert golden mole (*Eremitalpa granti*): A review, *Journal of Comparative Psychology,* 116(2), 158–163.

Mass, A. M., and Supin, A. Y. (1995) Ganglion cell topography of the retina in the bottlenosed dolphin, *Tursiops truncatus, Brain, Behavior and Evolution,* 45(5), 257–265.

Mass, A. M., and Supin, A. Y. (2007) Adaptive features of aquatic mammals' eye, *The Ana- tomical Record,* 290(6), 701–715.

Masters, W. M. (1984) Vibrations in the orbwebs of *Nuctenea sclopetaria* (Araneidae). I. Trans- mission through the web, *Behavioral Ecology and Sociobiology,* 15(3), 207–215.

Matos-Cruz, V., et al. (2017) Molecular prerequisites for diminished cold sensitivity in ground squirrels and hamsters, *Cell Reports,* 21(12), 3329–3337.

Maximov, V. V. (2000) Environmental factors which may have led to the appearance of colour vision, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 355(1401), 1239– 1242.

McArthur, C., et al. (2019) Plant volatiles are a salient cue for foraging mammals: Elephants target preferred plants despite background plant odour, *Animal Behaviour,* 155, 199–216.

McBride, C. S. (2016) Genes and odors underlying the recent evolution of mosquito preference for humans, *Current Biology,* 26(1), R41–R46.

McBride, C. S., et al. (2014) Evolution of mosquito preference for humans linked to an odorant receptor, *Nature,* 515(7526), 222–227.

McCulloch, K. J., Osorio, D., and Briscoe, A. D. (2016) Sexual dimorphism in the compound eye of *Heliconius erato*: A

nymphalid butterfly with at least five spectral classes of photore- ceptor, *Journal of Experimental Biology,* 219(15), 2377–2387.

McGann, J. P. (2017) Poor human olfaction is a 19th-century myth, *Science,* 356(6338), eaam7263. McGregor, P. K., and Westby, G. M. (1992) Discrimination of individually characteristic elec-

tric organ discharges by a weakly electric fish, *Animal Behaviour,* 43(6), 977–986.

McKemy, D. D. (2007) Temperature sensing across species, *Pflügers Archiv—European Journal of Physiology,* 454(5), 777–791.

McKenzie, S. K., and Kronauer, D. J. C. (2018) The genomic architecture and molecular evolu- tion of ant odorant receptors, *Genome Research,* 28(11), 1757–1765.

McMeniman, C. J., et al. (2014) Multimodal integration of carbon dioxide and other sensory cues drives mosquito attraction to humans, *Cell,* 156(5), 1060–1071. Meister, M. (2016) Physical limits to magnetogenetics, *eLife,* 5, e17210.

Melin, A. D., et al. (2007) Effects of colour vision phenotype on insect capture by a free- ranging population of white-faced capuchins, *Cebus capucinus, Animal Behaviour,* 73(1), 205–214.

Melin, A. D., et al. (2016) Zebra stripes through the eyes of their predators, zebras, and hu- mans, *PLOS One,* 11(1), e0145679.

Melin, A. D., et al. (2017) Trichromacy increases fruit intake rates of wild capuchins (*Cebus capucinus imitator*), *Proceedings of the National Academy of Sciences,* 114(39), 10402–10407.

Melo, N., et al. (2021) The irritant receptor TRPA1 mediates the mosquito repellent effect of catnip, *Current Biology,* 31(9), 1988–1994.e5.

Mencinger-Vračko, B., and Devetak, D. (2008) Orientation of the pit-building antlion larva *Euroleon* (Neuroptera, Myrmeleontidae) to the direction of substrate vibrations caused by prey, *Zoology,* 111(1), 2–8.

Menda, G., et al. (2019) The long and short of hearing in the mosquito *Aedes aegypti, Current Biology,* 29(4), 709–714.e4.

Merkel, F. W., and Fromme, H. G. (1958) Untersuchungen über das Orientierungsvermögen nächtlich ziehender Rotkehlchen, *Naturwissenschaften,* 45(2), 499–500.

Merker, B. (2005) The liabilities of mobility: A selection pressure for the transition to con-sciousness in animal evolution, *Consciousness and Cognition,* 14(1), 89–114.

Mettam, J. J., et al. (2011) The efficacy of three types of analgesic drugs in reducing pain in the rainbow trout, *Oncorhynchus mykiss, Applied Animal Behaviour Science,* 133(3), 265–274.

Meyer-Rochow, V. B. (1978) The eyes of mesopelagic crustaceans. II. *Streetsia challengeri* (am- phipoda), *Cell and Tissue Research,* 186(2), 337–349.

Mhatre, N., Sivalinghem, S., and Mason, A. C. (2018) Posture controls mechanical tuning in the black widow spider mechanosensory system, bioRxiv. Available at: biorxiv.org/lookup/doi/10.1101/484238.

Middendorff, A. T. (1855) *Die Isepiptesen Russlands: Grundlagen zur Erforschung der Zugzeiten und Zugrichtungen der Vögel Russlands.* St. Petersburg: Academie impériale des Sciences.

Miles, R. N., Robert, D., and Hoy, R. R. (1995) Mechanically coupled ears for directional hearing in the parasitoid fly *Ormia ochracea, Journal of the Acoustical Society of America,* 98(6), 3059–3070.

Miller, A. K., Hensman, M. C., et al. (2015) African elephants (*Loxodonta africana*) can detect TNT using olfaction: Implications for biosensor application, *Applied Animal Behaviour Sci- ence,* 171, 177–183.

Miller, A. K., Maritz, B., et al. (2015) An ambusher's arsenal: Chemical crypsis in the puff adder (*Bitis arietans*), *Proceedings of the Royal Society B: Biological Sciences,* 282(1821), 20152182.

Miller, P. J. O., Kvadsheim, P. H., et al. (2015) First indications that northern bottlenose whales are sensitive to behavioural disturbance from anthropogenic noise, *Royal Society Open Sci- ence,* 2(6), 140484.

Millsopp, S., and Laming, P. (2008) Trade-offs between feeding and shock avoidance in gold- fish (*Carassius auratus*), *Applied Animal Behaviour Science,* 113(1), 247–254.

Mitchinson, B., et al. (2011) Active vibrissal sensing in rodents and marsupials, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 366(1581), 3037–3048.

Mitkus, M., et al. (2018) Raptor vision, in Sherman, S. M. (ed), *Oxford research encyclopedia of neuroscience.* Oxford: Oxford University Press.

Mitra, O., et al. (2009) Grunting for worms: Seismic vibrations cause *Diplocardia* earthworms to emerge from the soil, *Biology Letters,* 5(1), 16–19.

Moayedi, Y., Nakatani, M., and Lumpkin, E. (2015) Mammalian mechanoreception, *Scholarpe- dia,* 10(3), 7265.

Modrell, M. S., et al. (2011) Electrosensory ampullary organs are derived from lateral line plac- odes in bony fishes, *Nature Communications,* 2(1), 496.

Mogdans, J. (2019) Sensory ecology of the fish lateral-line system: Morphological and physiological adaptations for the perception of hydrodynamic stimuli, *Journal of Fish Biology,* 95(1), 53–72.

Møhl, B., et al. (2003) The monopulsed nature of sperm whale clicks, *Journal of the Acoustical Society of America,* 114(2), 1143–1154.

Moir, H. M., Jackson, J. C., and Windmill, J. F. C. (2013) Extremely high frequency sensitivity in a "simple" ear, *Biology Letters,* 9(4), 20130241.

Mollon, J. D. (1989) "Tho' she kneel'd in that place where they grew . . .": The uses and origins of primate colour vision, *Journal of Experimental Biology,* 146, 21–38.

Monnin, T., et al. (2002) Pretender punishment induced by chemical signalling in a queenless ant, *Nature,* 419(6902), 61–65.

Montague, M. J., Danek-Gontard, M., and Kunc, H. P. (2013) Phenotypic plasticity affects the response of a sexually selected trait to anthropogenic noise, *Behavioral Ecology,* 24(2), 343– 348.

Montealegre-Z, F., et al. (2012) Convergent evolution between insect and mammalian audi- tion, *Science,* 338(6109), 968–971.

Monterey Bay Aquarium (2016) Say hello to Selka!, Monterey Bay Aquarium. Available at: montereybayaquarium.tumblr.com/post/149326681398/say-hello-to-selka.

Montgomery, J., Bleckmann, H., and Coombs, S. (2013) Sensory ecology and neuroethology of the lateral line, in Coombs, S., et al. (eds), *The lateral line system,* 121–150. New York: Springer.

Montgomery, J. C., and Saunders, A. J. (1985) Functional morphology of the piper *Hyporham- phus ihi* with reference to the role of the lateral line in feeding, *Proceedings of the Royal Soci- ety B: Biological Sciences,* 224(1235), 197–208.

Mooney, T. A., Yamato, M., and Branstetter, B. K. (2012) Hearing in cetaceans: From natural history to experimental biology, *Advances in marine biology,* 63, 197–246.

Moore, B., et al. (2017) Structure and function of regional specializations in the vertebrate retina, in Kaas, J. H., and Streidter, G. (eds), *Evolution of nervous systems,* 351–372. Oxford, UK: Academic Press.

Moran, D., Softley, R., and Warrant, E. J. (2015) The energetic cost of vision and the evolution of eyeless Mexican cavefish, *Science Advances,* 1(8), e1500363.

Moreau, C. S., et al. (2006) Phylogeny of the ants: Diversification in the age of angiosperms, *Science,* 312(5770), 101–104.

Morehouse, N. (2020) Spider vision, *Current Biology,* 30(17), R975–R980.

Moreira, L. A. A., et al. (2019) Platyrrhine color signals: New horizons to pursue, *Evolutionary Anthropology: Issues, News, and Reviews,* 28(5), 236–248.

Morley, E. L., and Robert, D. (2018) Electric fields elicit ballooning in spiders, *Current Biology,* 28(14), 2324–2330.e2.

Mortimer, B. (2017) Biotremology: Do physical constraints limit the propagation of vibra- tional information?, *Animal Behaviour,* 130, 165–174.

Mortimer, B., et al. (2014) The speed of sound in silk: Linking material performance to biological function, *Advanced Materials,* 26(30), 5179–5183.

Mortimer, B., et al. (2016) Tuning the instrument: Sonic properties in the spider's web, *Journal of the Royal Society Interface,* 13(122), 20160341.

Mortimer, J. A., and Portier, K. M. (1989) Reproductive homing and internesting behavior of the green turtle (*Chelonia mydas*) at Ascension Island, South Atlantic Ocean, *Copeia,* 1989(4), 962–977.

Moss, C. F. (2018) Auditory mechanisms of echolocation in bats, in Sherman, S. M. (ed), *Oxford research encyclopedia of neuroscience.* Oxford: Oxford University Press.

Moss, C. F., et al. (2006) Active listening for spatial orientation in a complex auditory scene, *PLOS Biology,* 4(4), e79.

Moss, C. F., Chiu, C., and Surlykke, A. (2011) Adaptive vocal behavior drives perception by echolocation in bats, *Current Opinion in Neurobiology,* 21(4), 645–652.

Moss, C. F., and Schnitzler, H.-U. (1995) Behavioral studies of auditory information processing, in Popper, A. N., and Fay, R. R. (eds), *Hearing by bats,* 87–145. New York: Springer.

Moss, C. F., and Surlykke, A. (2010) Probing the natural scene by echolocation in bats, *Frontiers in Behavioral Neuroscience,* 4, 33.

Moss, C. J. (2000) *Elephant memories: Thirteen years in the life of an elephant family*. Chicago: Uni- versity of Chicago Press.

Mouritsen, H. (2018) Long-distance navigation and magnetoreception in migratory animals, *Nature,* 558(7708), 50–59.

Mouritsen, H., et al. (2005) Night-vision brain area in migratory songbirds, *Proceedings of the National Academy of Sciences,* 102(23), 8339–8344.

Mourlam, M. J., and Orliac, M. J. (2017) Infrasonic and ultrasonic hearing evolved after the emergence of modern whales, *Current Biology,* 27(12), 1776–1781.e9.

Mugan, U., and MacIver, M. A. (2019) The shift from life in water to life on land advantaged planning in visually-guided behavior, bioRxiv, 585760.

Müller, P., and Robert, D. (2002) Death comes suddenly to the unprepared: Singing crickets, call fragmentation, and parasitoid flies, *Behavioral Ecology,* 13(5), 598–606.

Murchy, K. A., et al. (2019) Impacts of noise on the behavior and physiology of marine inver-

tebrates: A meta-analysis, *Proceedings of Meetings on Acoustics,* 37(1), 040002.

Murphy, C. T., Reichmuth, C., and Mann, D. (2015) Vibrissal sensitivity in a harbor seal (*Phoca vitulina*), *Journal of Experimental Biology,* 218(15), 2463–2471.

Murray, R. W. (1960) Electrical sensitivity of the ampullæ of Lorenzini, *Nature,* 187(4741), 957. Nachtigall, P. E. (2016) Biosonar and sound localization in dolphins, in Sherman, S. M. (ed), *Oxford research encyclopedia of neuroscience.* New York: Oxford University Press.

Nachtigall, P. E., and Supin, A. Y. (2008) A false killer whale adjusts its hearing when it echo- locates, *Journal of Experimental Biology,* 211(11), 1714–1718.

Nagel, T. (1974) What is it like to be a bat?, *The Philosophical Review,* 83(4), 435–450.

Nakano, R., et al. (2009) Moths are not silent, but whisper ultrasonic courtship songs, *Journal of Experimental Biology,* 212(24), 4072–4078.

Nakano, R., et al. (2010) To females of a noctuid moth, male courtship songs are nothing more than bat echolocation calls, *Biology Letters,* 6(5), 582–584.

Nakata, K. (2010) Attention focusing in a sit-and-wait forager: A spider controls its preydetection ability in different web sectors by adjusting thread tension, *Proceedings of the Royal Society B: Biological Sciences,* 277(1678), 29–33.

Nakata, K. (2013) Spatial learning affects thread tension control in orb-web spiders, *Biology Let- ters,* 9(4), 20130052.

Narins, P. M., and Lewis, E. R. (1984) The vertebrate ear as an exquisite seismic sensor, *Journal of the Acoustical Society of America,* 76(5), 1384–1387.

Narins, P. M., Stoeger, A. S., and O'Connell-Rodwell, C. (2016) Infrasonic and seismic com- munication in the vertebrates with special emphasis on the Afrotheria: An update and future directions, in Suthers, R. A., et al. (eds), *Vertebrate sound production and acoustic communication,* 191–227. Cham: Springer.

Necker, R. (1985) Observations on the function of a slowly-adapting mechanoreceptor associated with filoplumes in the feathered skin of pigeons, *Journal of Comparative Physiology A,* 156(3), 391–394.

Neil, T. R., et al. (2020) Moth wings are acoustic metamaterials, *Proceedings of the National Academy of Sciences,* 117(49), 31134–31141.

Neitz, J., Carroll, J., and Neitz, M. (2001) Color vision: Almost reason enough for having eyes, *Optics & Photonics News,* 12(1), 26–33.

Neitz, J., Geist, T., and Jacobs, G. H. (1989) Color vision in the dog, *Visual Neuroscience,* 3(2), 119–125.

Nesher, N., et al. (2014) Self-recognition mechanism between skin and suckers prevents octo- pus arms from interfering with each other, *Current Biology,* 24(11), 1271–1275.

Neumeyer, C. (1992) Tetrachromatic color vision in goldfish: Evidence from color mixture experiments, *Journal of Comparative Physiology A,* 171(5), 639–649.

Neunuebel, J. P., et al. (2015) Female mice ultrasonically interact with males during courtship displays, *eLife,* 4, e06203.

Nevitt, G. (2000) Olfactory foraging by Antarctic procellariiform seabirds: Life at high Reyn- olds numbers, *Biological Bulletin,* 198(2), 245–253.

Nevitt, G. A. (2008) Sensory ecology on the high seas: The odor world of the procellariiform seabirds, *Journal of Experimental Biology,* 211(11), 1706–1713.

Nevitt, G. A., and Bonadonna, F. (2005) Sensitivity to dimethyl sulphide suggests a mechanism for olfactory navigation by seabirds, *Biology Letters,* 1(3), 303–305.

Nevitt, G. A., and Hagelin, J. C. (2009) Symposium overview: Olfaction in birds: A dedication to the pioneering spirit of Bernice Wenzel and Betsy Bang, *Annals of the New York Academy of Sciences,* 1170(1), 424–427.

Nevitt, G. A., Losekoot, M., and Weimerskirch, H. (2008) Evidence for olfactory search in wandering albatross, *Diomedea exulans, Proceedings of the National Academy of Sciences,* 105(12), 4576–4581.

Nevitt, G. A., Veit, R. R., and Kareiva, P. (1995) Dimethyl sulphide as a foraging cue for Ant- arctic procellariiform seabirds, *Nature,* 376(6542), 680–682.

Newman, E. A., and Hartline, P. H. (1982) The infrared "vision" of snakes, *Scientific American,* 246(3), 116–127.

Nicolson, A. (2018) *The seabird's cry.* New York: Henry Holt.

Niesterok, B., et al. (2017) Hydrodynamic detection and localization of artificial flatfish breath- ing currents by harbour seals (*Phoca vitulina*), *Journal of Experimental Biology,* 220(2), 174– 185.

Niimura, Y., Matsui, A., and Touhara, K. (2014) Extreme expansion of the olfactory receptor gene repertoire in African elephants and evolutionary dynamics of orthologous gene groups in 13 placental mammals, *Genome Research,* 24(9), 1485–1496.

Nilsson, D.-E. (2009) The evolution of eyes and visually guided behaviour, *Philosophical Trans- actions of the Royal Society B: Biological Sciences,* 364(1531), 2833–2847.

Nilsson, D.-E., et al. (2012) A unique advantage for giant eyes in giant squid, *Current Biology,* 22(8), 683–688.

Nilsson, D.-E., and Pelger, S. (1994) A pessimistic estimate of the time required for an eye to evolve, *Proceedings of the Royal Society B: Biological Sciences,* 256(1345), 53–58.

Nilsson, G. (1996) Brain and body oxygen requirements of *Gnathonemus petersii,* a fish with an exceptionally large brain, *Journal of Experimental Biology,* 199(3), 603–607.

Nimpf, S., et al. (2019) A putative mechanism for magnetoreception by electromagnetic induc- tion in the pigeon inner ear, *Current Biology,* 29(23), 4052–4059.e4.

Niven, J. E., and Laughlin, S. B. (2008) Energy limitation as a selective pressure on the evolution of sensory systems, *Journal of Experimental Biology,* 211(Pt 11), 1792–1804.

Noble, G. K., and Schmidt, A. (1937) The structure and function of the facial and labial pits of snakes, *Proceedings of the American Philosophical Society,* 77(3), 263–288.

Noirot, E. (1966) Ultra-sounds in young rodents. I. Changes with age in albino mice, *Animal Behaviour,* 14(4), 459–462.

Noirot, I. C., et al. (2009) Presence of aromatase and estrogen receptor alpha in the inner ear of zebra finches, *Hearing Research,* 252(1–2), 49–55.

Nordmann, G. C., Hochstoeger, T., and Keays, D. A. (2017) Magnetoreception—A sense without a receptor, *PLOS Biology,* 15(10), e2003234.

Norman, L. J., and Thaler, L. (2019) Retinotopic-like maps of spatial sound in primary "visual" cortex of blind human echolocators, *Proceedings of the Royal Society B: Biological Sciences,* 286(1912), 20191910.

Norris, K. S., et al. (1961) An experimental demonstration of echolocation behavior in the porpoise, *Tursiops truncatus* (Montagu), *Biological Bulletin,* 120(2), 163–176.

Ntelezos, A., Guarato, F., and Windmill, J. F. C. (2016) The anti-bat strategy of ultrasound absorption: The wings of nocturnal moths (Bombycoidea: Saturniidae) absorb more ul- trasound than the wings of diurnal moths (Chalcosiinae: Zygaenoidea: Zygaenidae), *Biol- ogy Open,* 6(1), 109–117.

O'Carroll, D. C., and Warrant, E. J. (2017) Vision in dim light: Highlights and challenges, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 372(1717), 20160062.

O'Connell, C. (2008) *The elephant's secret sense: The hidden life of the wild herds of Africa.* Chicago: University of Chicago Press.

O'Connell, C. E., Arnason, B. T., and Hart, L. A. (1997) Seismic transmission of elephant vo- calizations and movement, *Journal of the Acoustical Society of America,* 102(5), 3124.

O'Connell-Rodwell, C. E., et al. (2006) Wild elephant (*Loxodonta africana*) breeding herds re- spond to artificially transmitted seismic stimuli, *Behavioral Ecology and Sociobiology,* 59(6), 842–850.

O'Connell-Rodwell, C. E., et al. (2007) Wild African elephants (*Loxodonta africana*) discrimi- nate between familiar and unfamiliar conspecific seismic alarm calls, *Journal of the Acoustical Society of America,* 122(2), 823–830.

O'Connell-Rodwell, C. E., Hart, L. A., and Arnason, B. T. (2001) Exploring the potential use of seismic waves as a

communication channel by elephants and other large mammals, *American Zoologist,* 41(5), 1157–1170.
Olson, C. R., et al. (2018) Black Jacobin hummingbirds vocalize above the known hearing range of birds, *Current Biology,* 28(5), R204–R205.
Osorio, D., and Vorobyev, M. (1996) Colour vision as an adaptation to frugivory in primates, *Proceedings of the Royal Society B: Biological Sciences,* 263(1370), 593–599.
Osorio, D., and Vorobyev, M. (2008) A review of the evolution of animal colour vision and visual communication signals, *Vision Research,* 48(20), 2042–2051.
Ossiannilsson, F. (1949) Insect drummers, a study on the morphology and function of the sound-producing organ of Swedish *Homoptera auchenorrhyncha,* with notes on their sound- production. Dissertation, Entomologika sällskapet i Lund.
Owen, M. A., et al. (2015) An experimental investigation of chemical communication in the polar bear: Scent communication in polar bears, *Journal of Zoology,* 295(1), 36–43.
Owens, A. C. S., et al. (2020) Light pollution is a driver of insect declines, *Biological Conserva- tion,* 241, 108259.
Owens, G. L., et al. (2012) In the four-eyed fish (*Anableps anableps*), the regions of the retina exposed to aquatic and aerial light do not express the same set of opsin genes, *Biology Let- ters,* 8(1), 86–89.
Pack, A., and Herman, L. (1995) Sensory integration in the bottlenosed dolphin: Immediate recognition of complex shapes across the senses of echolocation and vision, *Journal of the Acoustical Society of America,* 98, 722–33.
Page, R. A., and Ryan, M. J. (2008) The effect of signal complexity on localization perfor- mance in bats that localize frog calls, *Animal Behaviour,* 76(3), 761–769.
Pain, S. (2001) Stench warfare, *New Scientist.* Available at: www.newscientist.com/article/ mg17122984-600-stench-warfare/.

Palmer, B. A., et al. (2017) The image-forming mirror in the eye of the scallop, *Science,* 358(6367), 1172–1175.

Panksepp, J., and Burgdorf, J. (2000) 50-kHz chirping (laughter?) in response to conditioned and unconditioned tickle-induced reward in rats: Effects of social housing and genetic variables, *Behavioural Brain Research,* 115(1), 25–38.

Park, T. J., et al. (2008) Selective inflammatory pain insensitivity in the African naked mole-rat (*Heterocephalus glaber*), *PLOS Biology,* 6(1), e13.

Park, T. J., et al. (2017) Fructose-driven glycolysis supports anoxia resistance in the naked mole-rat, *Science,* 356(6335), 307–311.

Park, T. J., Lewin, G. R., and Buffenstein, R. (2010) Naked mole rats: Their extraordinary sensory world, in Breed, M., and Moore, J. (eds), *Encyclopedia of animal behavior,* 505–512. Amsterdam: Elsevier.

Parker, A. (2004) *In the blink of an eye: How vision sparked the big bang of evolution.* New York: Basic Books.

Partridge, B. L., and Pitcher, T. J. (1980) The sensory basis of fish schools: Relative roles of lateral line and vision, *Journal of Comparative Physiology,* 135(4), 315–325.

Partridge, J. C., et al. (2014) Reflecting optics in the diverticular eye of a deep-sea barreleye fish (*Rhynchohyalus natalensis*), *Proceedings of the Royal Society B: Biological Sciences,* 281(1782), 20133223.

Patek, S. N., Korff, W. L., and Caldwell, R. L. (2004) Deadly strike mechanism of a mantis shrimp, *Nature,* 428(6985), 819–820.

Patton, P., Windsor, S., and Coombs, S. (2010) Active wall following by Mexican blind cavefish (*Astyanax mexicanus*), *Journal of Comparative Physiology A,* 196(11), 853–867.

Paul, S. C., and Stevens, M. (2020) Horse vision and obstacle visibility in horseracing, *Applied Animal Behaviour Science,* 222, 104882.

Paulin, M. G. (1995) Electroreception and the compass sense of sharks, *Journal of Theoretical Biology,* 174(3), 325–339.
Payne, K. (1999) *Silent thunder: In the presence of elephants.* London: Penguin.
Payne, K. B., Langbauer, W. R., and Thomas, E. M. (1986) Infrasonic calls of the Asian ele- phant (*Elephas maximus*), *Behavioral Ecology and Sociobiology,* 18(4), 297–301.
Payne, R. S. (1971) Acoustic location of prey by barn owls (*Tyto alba*), *Journal of Experimental Biology,* 54(3), 535–573.
Payne, R. S., and McVay, S. (1971) Songs of humpback whales, *Science,* 173(3997), 585–597. Payne, R., and Webb, D. (1971) Orientation by means of long range acoustic signaling in baleen whales, *Annals of the New York Academy of Sciences,* 188(1 Orientation), 110–141.
Peichl, L. (2005) Diversity of mammalian photoreceptor properties: Adaptations to habitat and lifestyle?, *The Anatomical Record Part A: Discoveries in Molecular, Cellular, and Evolution- ary Biology,* 287A(1), 1001–1012.
Peichl, L., Behrmann, G., and Kröger, R. H. (2001) For whales and seals the ocean is not blue: A visual pigment loss in marine mammals, *The European Journal of Neuroscience,* 13(8), 1520– 1528.
Perry, M. W., and Desplan, C. (2016) Love spots, *Current Biology,* 26(12), R484–R485. Persons, W. S., and Currie, P. J. (2015) Bristles before down: A new perspective on the functional origin of feathers, *Evolution: International Journal of Organic Evolution,* 69(4), 857–862. Pettigrew, J. D., Manger, P. R., and Fine, S. L. B. (1998) The sensory world of the platypus,
Philosophical Transactions of the Royal Society B: Biological Sciences, 353(1372), 1199–1210.
Phillips, J. N., et al. (2019) Background noise disrupts host-parasitoid interactions, *Royal Society Open Science,* 6(9), 190867.

Phippen, J. W. (2016) "Kill every buffalo you can! Every buffalo dead is an Indian gone," *The Atlantic*. Available at: www.theatlantic.com/national/archive/2016/05/the-buffalo-killers/ 482349/.

Picciani, N., et al. (2018) Prolific origination of eyes in Cnidaria with co-option of non-visual opsins, *Current Biology,* 28(15), 2413–2419.e4.

Piersma, T., et al. (1995) Holling's functional response model as a tool to link the food-finding mechanism of a probing shorebird with its spatial distribution, *Journal of Animal Ecology,* 64(4), 493–504.

Piersma, T., et al. (1998) A new pressure sensory mechanism for prey detection in birds: The use of principles of seabed dynamics?, *Proceedings of the Royal Society B: Biological Sciences,* 265(1404), 1377–1383.

Pihlström, H., et al. (2005) Scaling of mammalian ethmoid bones can predict olfactory organ size and performance, *Proceedings of the Royal Society B: Biological Sciences,* 272(1566), 957–962. Pitcher, T. J., Partridge, B. L., and Wardle, C. S. (1976) A blind fish can school, *Science,* 194(4268), 963–965.

Plachetzki, D. C., Fong, C. R., and Oakley, T. H. (2012) Cnidocyte discharge is regulated by light and opsin-mediated phototransduction, *BMC Biology,* 10(1), 17.

Plotnik, J. M., et al. (2019) Elephants have a nose for quantity, *Proceedings of the National Academy of Sciences,* 116(25), 12566–12571.

Pointer, M. R., and Attridge, G. G. (1998) The number of discernible colours, *Color Research & Application,* 23(1), 52–54.

Polajnar, J., et al. (2015) Manipulating behaviour with substrate-borne vibrations—Potential for insect pest control, *Pest Management Science,* 71(1), 15–23.

Polilov, A. A. (2012) The smallest insects evolve anucleate neurons, *Arthropod Structure & Devel- opment,* 41(1), 29–34.

Pollack, L. (2012) Historical series: Magnetic sense of birds. Available at: www.ks.uiuc.edu/ History/magnetoreception/.

Poole, J. H., et al. (1988) The social contexts of some very low frequency calls of African ele- phants, *Behavioral Ecology and Sociobiology,* 22(6), 385–392.

Popper, A. N., et al. (2004) Response of clupeid fish to ultrasound: A review, *ICES Journal of Marine Science,* 61(7), 1057–1061.

Porter, J., et al. (2007) Mechanisms of scent-tracking in humans, *Nature Neuroscience,* 10(1), 27–29.

Porter, M. L., et al. (2012) Shedding new light on opsin evolution, *Proceedings of the Royal Society B: Biological Sciences,* 279(1726), 3–14.

Porter, M. L., and Sumner-Rooney, L. (2018) Evolution in the dark: Unifying our understand- ing of eye loss, *Integrative and Comparative Biology,* 58(3), 367–371.

Potier, S., et al. (2017) Eye size, fovea, and foraging ecology in accipitriform raptors, *Brain, Behavior and Evolution,* 90(3), 232–242.

Poulet, J. F. A., and Hedwig, B. (2003) A corollary discharge mechanism modulates central auditory processing in singing crickets, *Journal of Neurophysiology,* 89(3), 1528–1540.

Poulson, S. J., et al. (2020) Naked mole-rats lack cold sensitivity before and after nerve injury, *Molecular Pain,* 16, 1744806920955103.

Prescott, T. J., Diamond, M. E., and Wing, A. M. (2011) Active touch sensing, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 366(1581), 2989–2995.

Prescott, T. J., and Dürr, V. (2015) The world of touch, *Scholarpedia,* 10(4), 32688.

Prescott, T. J., Mitchinson, B., and Grant, R. (2011) Vibrissal behavior and function, *Scholarpe- dia,* 6(10), 6642.

Primack, R. B. (1982) Ultraviolet patterns in flowers, or flowers as viewed by insects, *Arnoldia,* 42(3), 139–146.

Prior, N. H., et al. (2018) Acoustic fine structure may encode biologically relevant information for zebra finches, *Scientific Reports,* 8(1), 6212.

Proske, U., and Gregory, E. (2003) Electrolocation in the platypus—Some speculations, *Com- parative Biochemistry and Physiology Part A: Molecular & Integrative Physiology,* 136(4), 821–825. Proust, M. (1993) *In search of lost time,* volume 5. Translated by C. K. Scott Moncrieff and Terence Kilmartin. New York: Modern Library.

Putman, N. F., et al. (2013) Evidence for geomagnetic imprinting as a homing mechanism in Pacific salmon, *Current Biology,* 23(4), 312–316.

Pye, D. (2004) Poem by David Pye: On the variety of hearing organs in insects, *Microscopic Research Techniques,* 63, 313–314.

Pyenson, N. D., et al. (2012) Discovery of a sensory organ that coordinates lunge feeding in rorqual whales, *Nature,* 485(7399), 498–501.

Pynn, L. K., and DeSouza, J. F. X. (2013) The function of efference copy signals: Implications for symptoms of schizophrenia, *Vision Research,* 76, 124–133.

Pytte, C. L., Ficken, M. S., Moiseff, A. (2004) Ultrasonic singing by the blue-throated hum- mingbird: A comparison between production and perception, *Journal of Comparative Phys- iology A,* 190(8), 665–673.

Qin, S., et al. (2016) A magnetic protein biocompass, *Nature Materials,* 15(2), 217–226. Quignon, P., et al. (2012) Genetics of canine olfaction and receptor diversity, *Mammalian Genome,* 23(1–2), 132–143.

Raad, H., et al. (2016) Functional gustatory role of chemoreceptors in *Drosophila* wings, *Cell Reports,* 15(7), 1442–1454.

Radinsky, L. B. (1968) Evolution of somatic sensory specialization in otter brains, *Journal of Comparative Neurology,* 134(4), 495–505.

Ramey, E., et al. (2013) Desert-dwelling African elephants (*Loxodonta africana*) in Namibia dig wells to purify drinking water, *Pachyderm,* 53, 66–72.

Ramey, S. (2020) *The lady's handbook for her mysterious illness.* London: Fleet.

Ramsier, M. A., et al. (2012) Primate communication in the pure ultrasound, *Biology Letters,* 8(4), 508–511.

Rasmussen, L. E. L., et al. (1996) Insect pheromone in elephants, *Nature,* 379(6567), 684. Rasmussen, L. E. L., and Krishnamurthy, V. (2000) How chemical signals integrate Asian elephant society: The known and the unknown, *Zoo Biology,* 19(5), 405–423.

Rasmussen, L. E. L., and Schulte, B. A. (1998) Chemical signals in the reproduction of Asian (*Elephas maximus*) and African (*Loxodonta africana*) elephants, *Animal Reproduction Science,* 53(1–4), 19–34.

Ratcliffe, J. M., et al. (2013) How the bat got its buzz, *Biology Letters,* 9(2), 20121031.

Ravaux, J., et al. (2013) Thermal limit for Metazoan life in question: In vivo heat tolerance of the Pompeii worm, *PLOS One,* 8(5), e64074.

Ravia, A., et al. (2020) A measure of smell enables the creation of olfactory metamers, *Nature,* 588(7836), 118–123.

Reep, R. L., Marshall, C. D., and Stoll, M. L. (2002) Tactile hairs on the postcranial body in Florida manatees: A mammalian lateral line?, *Brain, Behavior and Evolution,* 59(3), 141–154.

Reep, R., and Sarko, D. (2009) Tactile hair in manatees, *Scholarpedia,* 4(4), 6831.

Reilly, S. C., et al. (2008) Novel candidate genes identified in the brain during nociception in common carp (*Cyprinus*

carpio) and rainbow trout (*Oncorhynchus mykiss*), *Neuroscience Let- ters,* 437(2), 135–138.

Reymond, L. (1985) Spatial visual acuity of the eagle *Aquila audax:* A behavioural, optical and anatomical investigation, *Vision Research,* 25(10), 1477–1491.

Reynolds, R. P., et al. (2010) Noise in a laboratory animal facility from the human and mouse perspectives, *Journal of the American Association for Laboratory Animal Science,* 49(5), 592–597. Ridgway, S. H., and Au, W. W. L. (2009) Hearing and echolocation in dolphins, in Squire, L. R. (ed), *Encyclopedia of neuroscience,* 1031–1039. Amsterdam: Elsevier.

Riitters, K. H., and Wickham, J. D. (2003) How far to the nearest road?, *Frontiers in Ecology and the Environment,* 1(3), 125–129.

Ritz, T., Adem, S., and Schulten, K. (2000) A model for photoreceptor-based magneto- reception in birds, *Biophysical Journal,* 78(2), 707–718.

Robert, D., Amoroso, J., and Hoy, R. (1992) The evolutionary convergence of hearing in a parasitoid fly and its cricket host, *Science,* 258(5085), 1135–1137.

Robert, D., Mhatre, N., and McDonagh, T. (2010) The small and smart sensors of insect audi- tory systems, in *2010 Ninth IEEE Sensors Conference (SENSORS 2010),* 2208–2211. Kona, HI: IEEE. Available at: ieeexplore.ieee.org/document/5690624/.

Roberts, S. A., et al. (2010) Darcin: A male pheromone that stimulates female memory and sexual attraction to an individual male's odour, *BMC Biology,* 8(1), 75.

Robinson, M. H., and Mirick, H. (1971) The predatory behavior of the golden-web spider *Nephila clavipes* (Araneae: Araneidae), *Psyche,* 78(3), 123–139.

Rogers, L. J. (2012) The two hemispheres of the avian brain: Their differing roles in perceptual processing and the expression of behavior, *Journal of Ornithology,* 153(1), 61–74.

Rolland, R. M., et al. (2012) Evidence that ship noise increases stress in right whales, *Proceedings of the Royal Society B: Biological Sciences,* 279(1737), 2363–2368.

Ros, M. (1935) Die Lippengruben der Pythonen als Temperaturorgane, *Jenaische Zeitschrift für Naturwissenschaft,* 70, 1–32.

Rose, J. D., et al. (2014) Can fish really feel pain?, *Fish and Fisheries,* 15(1), 97–133.

Rowe, A. H., et al. (2013) Voltage-gated sodium channel in grasshopper mice defends against bark scorpion toxin, *Science,* 342(6157), 441–446.

Rubin, J. J., et al. (2018) The evolution of anti-bat sensory illusions in moths, *Science Advances,* 4(7), eaar7428.

Ruck, P. (1958) A comparison of the electrical responses of compound eyes and dorsal ocelli in four insect species, *Journal of Insect Physiology,* 2(4), 261–274.

Rundus, A. S., et al. (2007) Ground squirrels use an infrared signal to deter rattlesnake predation, *Proceedings of the National Academy of Sciences,* 104(36), 14372–14376.

Ryan, M. J. (1980) Female mate choice in a neotropical frog, *Science,* 209(4455), 523–525. Ryan, M. J. (2018) *A taste for the beautiful: The evolution of attraction.* Princeton, NJ: Princeton University Press.

Ryan, M. J., et al. (1990) Sexual selection for sensory exploitation in the frog *Physalaemus pus- tulosus, Nature,* 343(6253), 66–67.

Ryan, M. J., and Rand, A. S. (1993) Sexual selection and signal evolution: The ghost of biases past, *Philosophical Transactions of the Royal Society B: Biological Sciences,* 340(1292), 187–195.

Rycyk, A. M., et al. (2018) Manatee behavioral response to boats, *Marine Mammal Science,* 34(4), 924–962.

Ryerson, W. (2014) Why snakes flick their tongues: A fluid dynamics approach. Unpublished dissertation, University of Connecticut.

Sacks, O., and Wasserman, R. (1987) The case of the colorblind painter, *The New York Review of Books,* November 19. Available at: www.nybooks.com/articles/1987/11/19/the-case-of-the-colorblind-painter/.

Saito, C. A., et al. (2004) Alouatta trichromatic color vision—single-unit recording from retinal ganglion cells and microspectrophotometry, *Investigative Ophthalmology & Visual Science,* 45, 4276.

Salazar, V. L., Krahe, R., and Lewis, J. E. (2013) The energetics of electric organ discharge generation in gymnotiform weakly electric fish, *Journal of Experimental Biology,* 216(13), 2459–2468.

Sales, G. D. (2010) Ultrasonic calls of wild and wild-type rodents, in Brudzynski, S. (ed), *Hand- book of behavioral neuroscience,* vol. 19, 77–88. Amsterdam: Elsevier.

Sanders, D., et al. (2021) A meta-analysis of biological impacts of artificial light at night, *Nature Ecology & Evolution,* 5(1), 74–81.

Sarko, D. K., Rice, F. L., and Reep, R. L. (2015) Elaboration and innervation of the vibrissal system in the rock hyrax (*Procavia capensis*), *Brain, Behavior and Evolution,* 85(3), 170–188.

Savoca, M. S., et al. (2016) Marine plastic debris emits a keystone infochemical for olfactory foraging seabirds, *Science Advances,* 2(11), e1600395.

Sawtell, N. B. (2017) Neural mechanisms for predicting the sensory consequences of behavior: Insights from electrosensory systems, *Annual Review of Physiology,* 79(1), 381–399.

Scanlan, M. M., et al. (2018) Magnetic map in nonanadromous Atlantic salmon, *Proceedings of the National Academy of Sciences,* 115(43), 10995–10999.

Schevill, W. E., and McBride, A. F. (1956) Evidence for echolocation by cetaceans, *Deep Sea Research,* 3(2), 153–154.

Schevill, W. E., Watkins, W. A., and Backus, R. H. (1964) The 20-cycle signals and *Balaenoptera* (fin whales), in Tavolga, W. N. (ed), *Marine bio-acoustics,* 147–152. Oxford: Pergamon Press.

Schiestl, F. P., et al. (2000) Sex pheromone mimicry in the early spider orchid (*Ophrys sphe- godes*): Patterns of hydrocarbons as the key mechanism for pollination by sexual deception, *Journal of Comparative Physiology A,* 186(6), 567–574.

Schmitz, H., and Bleckmann, H. (1998) The photomechanic infrared receptor for the detection of forest fires in the beetle *Melanophila acuminata* (Coleoptera: Buprestidae), *Journal of Com- parative Physiology A,* 182(5), 647–657.

Schmitz, H., and Bousack, H. (2012) Modelling a historic oil-tank fire allows an estimation of the sensitivity of the infrared receptors in pyrophilous *Melanophila* beetles, *PLOS One,* 7(5), e37627.

Schmitz, H., Schmitz, A., and Schneider, E. S. (2016) Matched filter properties of infrared re- ceptors used for fire and heat detection in insects, in von der Emde, G., and Warrant, E. (eds), *The ecology of animal senses,* 207–234. Cham: Springer.

Schneider, E. R., et al. (2014) Neuronal mechanism for acute mechanosensitivity in tactileforaging waterfowl, *Proceedings of the National Academy of Sciences,* 111(41), 14941–14946.

Schneider, E. R., et al. (2017) Molecular basis of tactile specialization in the duck bill, *Proceed- ings of the National Academy of Sciences,* 114(49), 13036–13041.

Schneider, E. R., et al. (2019) A cross-species analysis reveals a general role for Piezo2 in mech- anosensory specialization of trigeminal ganglia from tactile specialist birds, *Cell Reports,* 26(8), 1979–1987.e3.

Schneider, E. S., Schmitz, A., and Schmitz, H. (2015) Concept of an active amplification mech- anism in the infrared organ

of pyrophilous *Melanophila* beetles, *Frontiers in Physiology,* 6, 391.

Schneider, W. T., et al. (2018) Vestigial singing behaviour persists after the evolutionary loss of song in crickets, *Biology Letters,* 14(2), 20170654.

Schneirla, T. C. (1944) A unique case of circular milling in ants, considered in relation to trail following and the general problem of orientation, *American Museum Novitates,* no. 1253. Schnitzler, H.-U. (1967) Kompensation von Dopplereffekten bei Hufeisen-Fledermäusen, *Naturwissenschaften,* 54(19), 523.

Schnitzler, H.-U. (1973) Control of Doppler shift compensation in the greater horseshoe bat, *Rhinolophus ferrumequinum, Journal of Comparative Physiology,* 82(1), 79–92.

Schnitzler, H.-U., and Denzinger, A. (2011) Auditory fovea and Doppler shift compensation: Adaptations for flutter detection in echolocating bats using CF-FM signals, *Journal of Comparative Physiology A,* 197(5), 541–559.

Schnitzler, H.-U., and Kalko, E. K. V. (2001) Echolocation by insect-eating bats, *BioScience,* 51(7), 557–569.

Schraft, H. A., Bakken, G. S., and Clark, R. W. (2019) Infrared-sensing snakes select ambush orientation based on thermal backgrounds, *Scientific Reports,* 9(1), 3950.

Schraft, H. A., and Clark, R. W. (2019) Sensory basis of navigation in snakes: The relative importance of eyes and pit organs, *Animal Behaviour,* 147, 77–82.

Schraft, H. A., Goodman, C., and Clark, R. W. (2018) Do free-ranging rattlesnakes use thermal cues to evaluate prey?, *Journal of Comparative Physiology A,* 204(3), 295–303.

Schrope, M. (2013) Giant squid filmed in its natural environment, *Nature,* doi.org/10.1038/ nature.2013.12202.

Schuergers, N., et al. (2016) Cyanobacteria use micro-optics to sense light direction, *eLife,* 5, e12620.

Schuller, G., and Pollak, G. (1979) Disproportionate frequency representation in the inferior colliculus of Doppler-compensating greater horseshoe bats: Evidence for an acoustic fovea, *Journal of Comparative Physiology,* 132(1), 47–54.

Schulten, K., Swenberg, C. E., and Weller, A. (1978) A biomagnetic sensory mechanism based on magnetic field modulated coherent electron spin motion, *Zeitschrift für Physikalische Chemie,* 111(1), 1–5.

Schumacher, S., et al. (2016) Cross-modal object recognition and dynamic weighting of sen- sory inputs in a fish, *Proceedings of the National Academy of Sciences,* 113(27), 7638–7643.

Schusterman, R. J., et al. (2000) Why pinnipeds don't echolocate, *Journal of the Acoustical Society of America,* 107(4), 2256–2264.

Schütz, S., et al. (1999) Insect antenna as a smoke detector, *Nature,* 398(6725), 298–299. Schwenk, K. (1994) Why snakes have forked tongues, *Science,* 263(5153), 1573–1577.

Secor, S. M. (2008) Digestive physiology of the Burmese python: Broad regulation of inte- grated performance, *Journal of Experimental Biology,* 211(24), 3767–3774.

Seehausen, O., et al. (2008) Speciation through sensory drive in cichlid fish, *Nature,* 455(7213), 620–626.

Seehausen, O., van Alphen, J. J. M., and Witte, F. (1997) Cichlid fish diversity threatened by eutrophication that curbs sexual selection, *Science,* 277(5333), 1808–1811.

Seidou, M., et al. (1990) On the three visual pigments in the retina of the firefly squid, *Watasenia scintillans, Journal of Comparative Physiology A,* 166, 769–773.

Seneviratne, S. S., and Jones, I. L. (2008) Mechanosensory function for facial ornamentation in the whiskered auklet, a crevice-dwelling seabird, *Behavioral Ecology,* 19(4), 784–790.

Sengupta, P., and Garrity, P. (2013) Sensing temperature, *Current Biology,* 23(8), R304–R307. Senzaki, M., et al. (2016) Traffic noise reduces foraging efficiency in wild owls, *Scientific Reports,* 6(1), 30602.

Sewell, G. D. (1970) Ultrasonic communication in rodents, *Nature,* 227(5256), 410.

Seyfarth, E.-A. (2002) Tactile body raising: Neuronal correlates of a "simple" behavior in spi- ders, in Toft, S., and Scharff, N. (eds), *European Arachnology 2000: Proceedings of the 19th Eu- ropean College of Arachnology,* 19–32. Aarhus: Aarhus University Press.

Shadwick, R. E., Potvin, J., and Goldbogen, J. A. (2019) Lunge feeding in rorqual whales, *Physiology,* 34(6), 409–418.

Shamble, P. S., et al. (2016) Airborne acoustic perception by a jumping spider, *Current Biology,* 26(21), 2913–2920.

Shan, L., et al. (2018) Lineage-specific evolution of bitter taste receptor genes in the giant and red pandas implies dietary adaptation, *Integrative Zoology,* 13(2), 152–159.

Shannon, G., et al. (2014) Road traffic noise modifies behaviour of a keystone species, *Animal Behaviour,* 94, 135–141.

Shannon, G., et al. (2016) A synthesis of two decades of research documenting the effects of noise on wildlife: Effects of anthropogenic noise on wildlife, *Biological Reviews,* 91(4), 982– 1005.

Sharma, K. R., et al. (2015) Cuticular hydrocarbon pheromones for social behavior and their coding in the ant antenna, *Cell Reports,* 12(8), 1261–1271.

Shaw, J., et al. (2015) Magnetic particle-mediated magnetoreception, *Journal of the Royal Society Interface,* 12(110), 20150499.

Sherrington, C. S. (1903) Qualitative difference of spinal reflex corresponding with qualitative difference of cutaneous stimulus, *Journal of Physiology,* 30(1), 39–46.

Shimozawa, T., Murakami, J., and Kumagai, T. (2003) Cricket wind receptors: Thermal noise for the highest sensitivity known, in Barth, F. G., Humphrey, J. A. C., and Secomb, T. W. (eds), *Sensors and sensing in biology and engineering,* 145–157. Vienna: Springer.

Shine, R., et al. (2002) Antipredator responses of free-ranging pit vipers (*Gloydius shedaoensis,* Viperidae), *Copeia,* 2002(3), 843–850.

Shine, R., et al. (2003) Chemosensory cues allow courting male garter snakes to assess body length and body condition of potential mates, *Behavioral Ecology and Sociobiology,* 54(2), 162–166.

Sidebotham, J. (1877) Singing mice, *Nature,* 17(419), 29.

Siebeck, U. E., et al. (2010) A species of reef fish that uses ultraviolet patterns for covert face recognition, *Current Biology,* 20(5), 407–410.

Sieck, M. H., and Wenzel, B. M. (1969) Electrical activity of the olfactory bulb of the pigeon, *Electroencephalography and Clinical Neurophysiology,* 26(1), 62–69.

Siemers, B. M., et al. (2009) Why do shrews twitter? Communication or simple echo-based orientation, *Biology Letters,* 5(5), 593–596.

Silpe, J. E., and Bassler, B. L. (2019) A host-produced quorum-sensing autoinducer controls a phage lysis-lysogeny decision, *Cell,* 176(1–2), 268–280.e13.

Simmons, J. A., Ferragamo, M. J., and Moss, C. F. (1998) Echo-delay resolution in sonar im- ages of the big brown bat, *Eptesicus fuscus, Proceedings of the National Academy of Sciences,* 95(21), 12647–12652.

Simmons, J. A., and Stein, R. A. (1980) Acoustic imaging in bat sonar: Echolocation signals and the evolution of echolocation, *Journal of Comparative Physiology,* 135(1), 61–84.

Simões, J. M., et al. (2021) Robustness and plasticity in *Drosophila* heat avoidance, *Nature Com- munications,* 12(1), 2044.

Simons, E. (2020) Backyard fly training and you, *Bay Nature.* Available at: baynature.org/article/ lord-of-the-flies/.

Simpson, S. D., et al. (2016) Anthropogenic noise increases fish mortality by predation, *Nature Communications,* 7(1), 10544.

Sisneros, J. A. (2009) Adaptive hearing in the vocal plainfin midshipman fish: Getting in tune for the breeding season and implications for acoustic communication, *Integrative Zoology,* 4(1), 33–42.

Skedung, L., et al. (2013) Feeling small: Exploring the tactile perception limits, *Scientific Re- ports,* 3(1), 2617.

Slabbekoorn, H., and Peet, M. (2003) Birds sing at a higher pitch in urban noise, *Nature,* 424(6946), 267.

Smith, A. C., et al. (2003) The effect of colour vision status on the detection and selection of fruits by tamarins (*Saguinus* spp.), *Journal of Experimental Biology,* 206(18), 3159–3165.

Smith, B., et al. (2004) A survey of frog odorous secretions, their possible functions and phylogenetic significance, *Applied Herpetology,* 2, 47–82.

Smith, C. F., et al. (2009) The spatial and reproductive ecology of the copperhead (*Agkistrodon contortrix*) at the northeastern extreme of its range, *Herpetological Monographs,* 23(1), 45–73. Smith, E. St. J., et al. (2011) The molecular basis of acid insensitivity in the African naked molerat, *Science,* 334(6062), 1557–1560.

Smith, E. St. J., Park, T. J., and Lewin, G. R. (2020) Independent evolution of pain insensitiv- ity in African mole-rats: Origins and mechanisms, *Journal of Comparative Physiology A,* 206(3), 313–325.

Smith, F. A., et al. (2018) Body size downgrading of mammals over the late Quaternary, *Sci- ence,* 360(6386), 310–313.

Smith, L. M., et al. (2020) Impacts of COVID-19-related social distancing measures on per- sonal environmental sound exposures, *Environmental Research Letters,* 15(10), 104094.

Sneddon, L. (2013) Do painful sensations and fear exist in fish?, in van der Kemp, T., and Lachance, M. (eds), *Animal suffering: From science to law,* 93–112. Toronto: Carswell.
Sneddon, L. U. (2018) Comparative physiology of nociception and pain, *Physiology,* 33(1), 63–73.
Sneddon, L. U. (2019) Evolution of nociception and pain: Evidence from fish models, *Philo- sophical Transactions of the Royal Society B: Biological Sciences,* 374(1785), 20190290.
Sneddon, L. U., et al. (2014) Defining and assessing animal pain, *Animal Behaviour,* 97, 201–212. Sneddon, L. U., Braithwaite, V. A., and Gentle, M. J. (2003a) Do fishes have nociceptors? Evi- dence for the evolution of a vertebrate sensory system, *Proceedings of the Royal Society B: Biological Sciences,* 270(1520), 1115–1121.
Sneddon, L. U., Braithwaite, V. A., and Gentle, M. J. (2003b) Novel object test: Examining nociception and fear in the rainbow trout, *Journal of Pain,* 4(8), 431–440.
Snyder, J. B., et al. (2007) Omnidirectional sensory and motor volumes in electric fish, *PLOS Biology,* 5(11), e301.
Soares, D. (2002) An ancient sensory organ in crocodilians, *Nature,* 417(6886), 241–242. Sobel, N., et al. (1999) The world smells different to each nostril, *Nature,* 402(6757), 35.
Solvi, C., Gutierrez Al-Khudhairy, S., and Chittka, L. (2020) Bumble bees display cross-modal object recognition between visual and tactile senses, *Science,* 367(6480), 910–912.
Speiser, D. I., and Johnsen, S. (2008a) Comparative morphology of the concave mirror eyes of scallops (Pectinoidea), *American Malacological Bulletin,* 26(1–2), 27–33.
Speiser, D. I., and Johnsen, S. (2008b) Scallops visually respond to the size and speed of virtual particles, *Journal of Experimental Biology,* 211(Pt 13), 2066–2070.
Sperry, R. W. (1950) Neural basis of the spontaneous optokinetic response produced by visual inversion, *Journal of Comparative and Physiological Psychology,* 43(6), 482–489.

Spoelstra, K., et al. (2017) Response of bats to light with different spectra: Light-shy and agile bat presence is affected by white and green, but not red light, *Proceedings of the Royal Society B: Biological Sciences,* 284(1855), 20170075.

Stack, D. W., et al. (2011) Reducing visitor noise levels at Muir Woods National Monument using experimental management, *Journal of the Acoustical Society of America,* 129(3), 1375– 1380.

Stager, K. E. (1964) The role of olfaction in food location by the turkey vulture (*Cathartes aura*), *Contributions in Science,* 81, 1–63.

Stamp Dawkins, M. (2002) What are birds looking at? Head movements and eye use in chick- ens, *Animal Behaviour,* 63(5), 991–998.

Standing Bear, L. (2006) *Land of the spotted eagle.* Lincoln: Bison Books.

Stangl, F. B., et al. (2005) Comments on the predator-prey relationship of the Texas kangaroo rat (*Dipodomys elator*) and barn owl (*Tyto alba*), *The American Midland Naturalist,* 153(1), 135– 141.

Stebbins, W. C. (1983) *The acoustic sense of animals.* Cambridge, MA: Harvard University Press. Steen, J. B., et al. (1996) Olfaction in bird dogs during hunting, *Acta Physiologica Scandinavica,* 157(1), 115–119.

Sterbing-D'Angelo, S. J., et al. (2017) Functional role of airflow-sensing hairs on the bat wing, *Journal of Neurophysiology,* 117(2), 705–712.

Sterbing-D'Angelo, S. J., and Moss, C. F. (2014) Air flow sensing in bats, in Bleckmann, H., Mogdans, J., and Coombs, S. L. (eds), *Flow sensing in air and water,* 197–213. Berlin: Springer.

Stevens, M., and Cuthill, I. C. (2007) Hidden messages: Are ultraviolet signals a special channel in avian communication?, *BioScience,* 57(6), 501–507.

Stiehl, W. D., Lalla, L., and Breazeal, C. (2004) A "somatic alphabet" approach to "sensitive skin," in *Proceedings, ICRA '04, IEEE International Conference on Robotics and Automation, 2004,* 3, 2865–2870. New Orleans: IEEE.

Stoddard, M. C., et al. (2019) I see your false colours: How artificial stimuli appear to different animal viewers, *Interface Focus,* 9(1), 20180053.

Stoddard, M. C., et al. (2020) Wild hummingbirds discriminate nonspectral colors, *Proceedings of the National Academy of Sciences,* 117(26), 15112–15122.

Stokkan, K.-A., et al. (2013) Shifting mirrors: Adaptive changes in retinal reflections to winter darkness in Arctic reindeer, *Proceedings of the Royal Society B: Biological Sciences,* 280(1773), 20132451.

Stowasser, A., et al. (2010) Biological bifocal lenses with image separation, *Current Biology,* 20(16), 1482–1486.

Strauß, J., and Stumpner, A. (2015) Selective forces on origin, adaptation and reduction of tympanal ears in insects, *Journal of Comparative Physiology A,* 201(1), 155–169.

Strobel, S. M., et al. (2018) Active touch in sea otters: In-air and underwater texture discrimination thresholds and behavioral strategies for paws and vibrissae, *Journal of Experimental Biology,* 221(18), jeb181347.

Suga, N., and Schlegel, P. (1972) Neural attenuation of responses to emitted sounds in echolo- cating bats, *Science,* 177(4043), 82–84.

Sukhum, K. V., et al. (2016) The costs of a big brain: Extreme encephalization results in higher energetic demand and reduced hypoxia tolerance in weakly electric African fishes, *Pro- ceedings of the Royal Society B: Biological Sciences,* 283(1845), 20162157.

Sullivan, J. J. (2013) One of us, *Lapham's Quarterly.* Available at: www.laphamsquarterly.org/ animals/one-us.

Sumbre, G., et al. (2006) Octopuses use a human-like strategy to control precise point-to-point arm movements, *Current Biology,* 16(8), 767–772.

Sumner-Rooney, L., et al. (2018) Whole-body photoreceptor networks are independent of "lenses" in brittle stars, *Proceedings of the Royal Society B: Biological Sciences,* 285(1871), 20172590.

Sumner-Rooney, L. H., et al. (2014) Do chitons have a compass? Evidence for magnetic sensi- tivity in *Polyplacophora, Journal of Natural History,* 48(45–48), 3033–3045.

Sumner-Rooney, L. H., et al. (2020) Extraocular vision in a brittle star is mediated by chro- matophore movement in response to ambient light, *Current Biology,* 30(2), 319–327.e4.

Supa, M., Cotzin, M., and Dallenbach, K. M. (1944) "Facial vision": The perception of obstacles by the blind, *The American Journal of Psychology,* 57(2), 133–183.

Suraci, J. P., et al. (2019) Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice, *Ecology Letters,* 22(10), 1578–1586.

Surlykke, A., et al. (eds), (2014) *Biosonar*. New York: Springer.

Surlykke, A., and Kalko, E. K. V. (2008) Echolocating bats cry out loud to detect their prey, *PLOS One,* 3(4), e2036.

Surlykke, A., Simmons, J. A., and Moss, C. F. (2016) Perceiving the world through echoloca- tion and vision, in Fenton, M. B., et al. (eds), *Bat bioacoustics,* 265–288. New York: Springer.

Suter, R. B. (1978) *Cyclosa turbinata* (Araneae, Araneidae): Prey discrimination via web-borne vibrations, *Behavioral Ecology and Sociobiology,* 3(3), 283–296.

Suthers, R. A. (1967) Comparative echolocation by fishing bats, *Journal of Mammalogy,* 48(1), 79–87.

Sutton, G. P., et al. (2016) Mechanosensory hairs in bumblebees (*Bombus terrestris*) detect weak electric fields, *Proceedings of the National Academy of Sciences,* 113(26), 7261–7265.

Swaddle, J. P., et al. (2015) A framework to assess evolutionary responses to anthropogenic light and sound, *Trends in Ecology & Evolution,* 30(9), 550–560.

Takeshita, F., and Murai, M. (2016) The vibrational signals that male fiddler crabs (*Uca lactea*) use to attract females into their burrows, *The Science of Nature,* 103, 49.

Tansley, K. (1965) *Vision in vertebrates.* London: Chapman and Hall.

Tautz, J., and Markl, H. (1978) Caterpillars detect flying wasps by hairs sensitive to airborne vibration, *Behavioral Ecology and Sociobiology,* 4(1), 101–110.

Tautz, J., and Rostás, M. (2008) Honeybee buzz attenuates plant damage by caterpillars, *Cur- rent Biology,* 18(24), R1125–R1126.

Taylor, C. J., and Yack, J. E. (2019) Hearing in caterpillars of the monarch butterfly (*Danaus plexippus*), *Journal of Experimental Biology,* 222(22), jeb211862.

Tedore, C., and Nilsson, D.-E. (2019) Avian UV vision enhances leaf surface contrasts in forest environments, *Nature Communications,* 10(1), 238.

Temple, S., et al. (2012) High-resolution polarisation vision in a cuttlefish, *Current Biology,* 22(4), R121–R122.

Ter Hofstede, H. M., and Ratcliffe, J. M. (2016) Evolutionary escalation: The bat-moth arms race, *Journal of Experimental Biology,* 219(11), 1589–1602.

Thaler, L., et al. (2017) Mouth-clicks used by blind expert human echolocators—Signal description and model based signal synthesis, *PLOS Computational Biology,* 13(8), e1005670. Thaler, L., et al. (2020) The flexible action system: Click-based echolocation may replace certain visual functionality for adaptive walking, *Journal of Experimental Psychology: Human Perception and Performance,* 46(1), 21–35.

Thaler, L., Arnott, S. R., and Goodale, M. A. (2011) Neural correlates of natural human echo- location in early and late blind echolocation experts, *PLOS One,* 6(5), e20162.

Thaler, L., and Goodale, M. A. (2016) Echolocation in humans: An overview, *Wiley Interdisci- plinary Reviews: Cognitive Science,* 7(6), 382–393.

Thoen, H. H., et al. (2014) A different form of color vision in mantis shrimp, *Science,* 343(6169), 411–413.

Thoma, V., et al. (2016) Functional dissociation in sweet taste receptor neurons between and within taste organs of *Drosophila, Nature Communications,* 7(1), 10678.

Thomas, K. N., Robison, B. H., and Johnsen, S. (2017) Two eyes for two purposes: In situ evidence for asymmetric vision in the cockeyed squids *Histioteuthis heteropsis* and *Stigmato- teuthis dofleini, Philosophical Transactions of the Royal Society B: Biological Sciences,* 372(1717), 20160069.

Thometz, N. M., et al. (2016) Trade-offs between energy maximization and parental care in a central place forager, the sea otter, *Behavioral Ecology,* 27(5), 1552–1566.

Thums, M., et al. (2013) Evidence for behavioural thermoregulation by the world's largest fish, *Journal of the Royal Society Interface,* 10(78), 20120477.

Tierney, K. B., et al. (2008) Salmon olfaction is impaired by an environmentally realistic pesti- cide mixture, *Environmental Science & Technology,* 42(13), 4996–5001.

Toda, Y., et al. (2021) Early origin of sweet perception in the songbird radiation, *Science,* 373(6551), 226–231.

Tracey, W. D. (2017) Nociception, *Current Biology,* 27(4), R129–R133.

Treiber, C. D., et al. (2012) Clusters of iron-rich cells in the upper beak of pigeons are macro- phages not magnetosensitive neurons, *Nature,* 484(7394), 367–370.

Treisman, D. (2010) Ants and answers: A conversation with E. O. Wilson, *The New Yorker.* Available at: www.newyorker.

com/books/page-turner/ants-and-answers-a-conversation-with-e-o-wilson.

Trible, W., et al. (2017) *Orco* mutagenesis causes loss of antennal lobe glomeruli and impaired social behavior in ants, *Cell,* 170(4), 727–735.e10.

Tricas, T. C., Michael, S. W., and Sisneros, J. A. (1995) Electrosensory optimization to conspe- cific phasic signals for mating, *Neuroscience Letters,* 202(1), 129–132.

Tsai, C.-C., et al. (2020) Physical and behavioral adaptations to prevent overheating of the living wings of butterflies, *Nature Communications,* 11(1), 551.

Tsujii, K., et al. (2018) Change in singing behavior of humpback whales caused by shipping noise, *PLOS One,* 13(10), e0204112.

Tumlinson, J. H., et al. (1971) Identification of the trail pheromone of a leaf-cutting ant, *Atta texana, Nature,* 234(5328), 348–349.

Turkel, W. J. (2013) *Spark from the deep: How shocking experiments with strongly electric fish powered scientific discovery.* Baltimore: Johns Hopkins University Press.

Tuthill, J. C., and Azim, E. (2018) Proprioception, *Current Biology,* 28(5), R194–R203.

Tuttle, M. D., and Ryan, M. J. (1981) Bat predation and the evolution of frog vocalizations in the neotropics, *Science,* 214(4521), 677–678.

Tyack, P. L. (1997) Studying how cetaceans use sound to explore their environment, in Owings, D. H., Beecher, M. D., and Thompson, N. S. (eds), *Perspectives in ethology,* vol. 12, 251–297. New York: Plenum Press.

Tyack, P. L., and Clark, C. W. (2000) Communication and acoustic behavior of dolphins and whales, in Au, W. W. L., Fay, R. R., and Popper, A. N. (eds), *Hearing by whales and dolphins,*156–224. New York: Springer.

Tyler, N. J. C., et al. (2014) Ultraviolet vision may enhance the ability of reindeer to discrimi- nate plants in snow, *Arctic,* 67(2), 159–166.

Uexküll, J. von (1909) *Umwelt und Innenwelt der Tiere.* Berlin: J. Springer.

Uexküll, J. von (2010) *A foray into the worlds of animals and humans: With a theory of meaning* (trans. J. D. O'Neil). Minneapolis: University of Minnesota Press.

Ulanovsky, N., and Moss, C. F. (2008) What the bat's voice tells the bat's brain, *Proceedings of the National Academy of Sciences,* 105(25), 8491–8498.

Ullrich-Luter, E. M., et al. (2011) Unique system of photoreceptors in sea urchin tube feet, *Proceedings of the National Academy of Sciences,* 108(20), 8367–8372.

Vaknin, Y., et al. (2000) The role of electrostatic forces in pollination, *Plant Systematics and Evolution,* 222(1), 133–142.

Van Buskirk, R. W., and Nevitt, G. A. (2008) The influence of developmental environment on the evolution of olfactory foraging behaviour in procellariiform seabirds, *Journal of Evolu- tionary Biology,* 21(1), 67–76.

Van der Horst, G., et al. (2011) Sperm structure and motility in the eusocial naked mole-rat, *Heterocephalus glaber:* A case of degenerative orthogenesis in the absence of sperm competi- tion?, *BMC Evolutionary Biology,* 11(1), 351.

Van Doren, B. M., et al. (2017) High-intensity urban light installation dramatically alters noctur- nal bird migration, *Proceedings of the National Academy of Sciences,* 114(42), 11175–11180.

Van Lenteren, J. C., et al. (2007) Structure and electrophysiological responses of gustatory organs on the ovipositor of the parasitoid *Leptopilina heterotoma, Arthropod Structure & De- velopment,* 36(3), 271–276.

Van Staaden, M. J., et al. (2003) Serial hearing organs in the atympanate grasshopper *Bullacris membracioides*

(Orthoptera, Pneumoridae), *Journal of Comparative Neurology,* 465(4), 579–592. Veilleux, C. C., and Kirk, E. C. (2014) Visual acuity in mammals: Effects of eye size and ecology, *Brain, Behavior and Evolution,* 83(1), 43–53.

Vélez, A., Ryoo, D. Y., and Carlson, B. A. (2018) Sensory specializations of mormyrid fish are associated with species differences in electric signal localization behavior, *Brain, Behavior and Evolution,* 92(3–4), 125–141.

Vernaleo, B. A., and Dooling, R. J. (2011) Relative salience of envelope and fine structure cues in zebra finch song, *Journal of the Acoustical Society of America,* 129(5), 3373–3383.

Vidal-Gadea, A., et al. (2015) Magnetosensitive neurons mediate geomagnetic orientation in *Caenorhabditis elegans, eLife,* 4, e07493.

Viguier, C. (1882) Le sens de l'orientation et ses organes chez les animaux et chez l'homme, *Revue philosophique de la France et de l'étranger,* 14, 1–36.

Viitala, J., et al. (1995) Attraction of kestrels to vole scent marks visible in ultraviolet light, *Nature,* 373(6513), 425–427.

Vogt, R. G., and Riddiford, L. M. (1981) Pheromone binding and inactivation by moth anten- nae, *Nature,* 293(5828), 161–163.

Vollrath, F. (1979a) Behaviour of the kleptoparasitic spider *Argyrodes elevatus* (Araneae, theridi- idae), *Animal Behaviour,* 27(Pt 2), 515–521.

Vollrath, F. (1979b) Vibrations: Their signal function for a spider kleptoparasite, *Science,* 205(4411), 1149–1151.

Von der Emde, G. (1990) Discrimination of objects through electrolocation in the weakly elec- tric fish, *Gnathonemus petersii, Journal of Comparative Physiology A,* 167, 413–421.

Von der Emde, G. (1999) Active electrolocation of objects in weakly electric fish, *Journal of Experimental Biology,* 202, 1205–1215.

Von der Emde, G., et al. (1998) Electric fish measure distance in the dark, *Nature,* 395(6705), 890–894.

Von der Emde, G., and Ruhl, T. (2016) Matched filtering in African weakly electric fish: Two senses with complementary filters, in von der Emde, G., and Warrant, E. (eds), *The ecology of animal senses,* 237–263. Cham: Springer.

Von der Emde, G., and Schnitzler, H.-U. (1990) Classification of insects by echolocating greater horseshoe bats, *Journal of Comparative Physiology A,* 167(3), 423–430.

Von Dürckheim, K. E. M., et al. (2018) African elephants (*Loxodonta africana*) display remark- able olfactory acuity in human scent matching to sample performance, *Applied Animal Behaviour Science,* 200, 123–129.

Von Holst, E., and Mittelstaedt, H. (1950) Das reafferenzprinzip, *Naturwissenschaften,* 37(20), 464–476.

Wackermannová, M., Pinc, L., and Jebavý, L. (2016) Olfactory sensitivity in mammalian spe- cies, *Physiological Research,* 65(3), 369–390.

Walker, D. B., et al. (2006) Naturalistic quantification of canine olfactory sensitivity, *Applied Animal Behaviour Science,* 97(2–4), 241–254.

Walsh, C. M., Bautista, D. M., and Lumpkin, E. A. (2015) Mammalian touch catches up, *Cur- rent Opinion in Neurobiology,* 34, 133–139.

Wang, C. X., et al. (2019) Transduction of the geomagnetic field as evidenced from alpha-band activity in the human brain, *eNeuro,* 6(2), ENEURO.0483-18.2019.

Ward, J. (2013) Synesthesia, *Annual Review of Psychology,* 64(1), 49–75.

Wardill, T., et al. (2013) The miniature dipteran killer fly *Coenosia attenuata* exhibits adaptable aerial prey capture strategies, *Frontiers of Physiology Conference Abstract: International Confer- ence on Invertebrate Vision,* doi:10.3389/conf.fphys.2013.25.00057.

Ware, H. E., et al. (2015) A phantom road experiment reveals traffic noise is an invisible source of habitat degradation, *Proceedings of the National Academy of Sciences,* 112(39), 12105–12109.

Warkentin, K. M. (1995) Adaptive plasticity in hatching age: A response to predation risk trade-offs, *Proceedings of the National Academy of Sciences,* 92(8), 3507–3510.

Warkentin, K. M. (2005) How do embryos assess risk? Vibrational cues in predator-induced hatching of red-eyed treefrogs, *Animal Behaviour,* 70(1), 59–71.

Warkentin, K. M. (2011) Environmentally cued hatching across taxa: Embryos respond to risk and opportunity, *Integrative and Comparative Biology,* 51(1), 14–25.

Warrant, E. J. (2017) The remarkable visual capacities of nocturnal insects: Vision at the limits

with small eyes and tiny brains, *Philosophical Transactions of the Royal Society B: Biological Sci- ences,* 372(1717), 20160063.

Warrant, E. J., et al. (2004) Nocturnal vision and landmark orientation in a tropical halictid bee, *Current Biology,* 14(15), 1309–1318.

Warrant, E., et al. (2016) The Australian bogong moth *Agrotis infusa:* A long-distance nocturnal navigator, *Frontiers in Behavioral Neuroscience,* 10, 77.

Warrant, E. J., and Locket, N. A. (2004) Vision in the deep sea, *Biological Reviews of the Cambridge Philosophical Society,* 79(3), 671–712.

Watanabe, T. (1999) The influence of energetic state on the form of stabilimentum built by *Octonoba sybotides* (Araneae: Uloboridae), *Ethology,* 105(8), 719–725.

Watanabe, T. (2000) Web tuning of an orb-web spider, *Octonoba sybotides,* regulates prey- catching behaviour, *Proceedings of the Royal Society B: Biological Sciences,* 267(1443), 565–569.

Webb, B. (1996) A cricket robot, *Scientific American.* Available at: www.scientificamerican.com/ article/a-cricket-robot/.

Webb, J. F. (2013) Morphological diversity, development, and evolution of the mechanosen- sory lateral line system, in Coombs, S., et al. (eds), *The lateral line system,* 17–72. New York: Springer.

Webster, D. B. (1962) A function of the enlarged middle-ear cavities of the kangaroo rat, *Dipodomys, Physiological Zoology,* 35(3), 248–255.

Webster, D. B., and Webster, M. (1971) Adaptive value of hearing and vision in kangaroo rat predator avoidance, *Brain, Behavior and Evolution,* 4(4), 310–322.

Webster, D. B., and Webster, M. (1980) Morphological adaptations of the ear in the rodent family heteromyidae, *American Zoologist,* 20(1), 247–254.

Weger, M., and Wagner, H. (2016) Morphological variations of leading-edge serrations in owls (*Strigiformes*), *PLOS One,* 11(3), e0149236.

Wehner, R. (1987) "Matched filters"—Neural models of the external world, *Journal of Com- parative Physiology A,* 161(4), 511–531.

Weiss, T., et al. (2020) Human olfaction without apparent olfactory bulbs, *Neuron,* 105(1), 35– 45.e5.

Wenzel, B. M., and Sieck, M. H. (1972) Olfactory perception and bulbar electrical activity in several avian species, *Physiology & Behavior,* 9(3), 287–293.

Wheeler, W. M. (1910) *Ants: Their structure, development and behavior.* New York: Columbia University Press.

Widder, E. (2019) The Medusa, NOAA Ocean Exploration. Available at: oceanexplorer.noaa .gov/ explorations/19biolum/background/medusa/medusa.html.

Wieskotten, S., et al. (2010) Hydrodynamic determination of the moving direction of an artificial fin by a harbour seal

(*Phoca vitulina*), *Journal of Experimental Biology,* 213(13), 2194–2200.

Wieskotten, S., et al. (2011) Hydrodynamic discrimination of wakes caused by objects of differ- ent size or shape in a harbour seal (*Phoca vitulina*), *Journal of Experimental Biology,* 214(11), 1922–1930.

Wignall, A. E., and Taylor, P. W. (2011) Assassin bug uses aggressive mimicry to lure spider prey, *Proceedings of the Royal Society B: Biological Sciences,* 278(1710), 1427–1433.

Wilcox, C., Van Sebille, E., and Hardesty, B. D. (2015) Threat of plastic pollution to seabirds is global, pervasive, and increasing, *Proceedings of the National Academy of Sciences,* 112(38), 11899–11904.

Wilcox, S. R., Jackson, R. R., and Gentile, K. (1996) Spiderweb smokescreens: Spider trick- ster uses background noise to mask stalking movements, *Animal Behaviour,* 51(2), 313–326. Williams, C. J., et al. (2019) Analgesia for non-mammalian vertebrates, *Current Opinion in Physiology,* 11, 75–84.

Wilson, D. R., and Hare, J. F. (2004) Ground squirrel uses ultrasonic alarms, *Nature,* 430(6999), 523.

Wilson, E. O. (2015) Pheromones and other stimuli we humans don't get, with E. O. Wilson, *Big Think.* Available at: bigthink.com/videos/eo-wilson-on-the-world-of-pheromones.

Wilson, E. O., Durlach, N. I., and Roth, L. M. (1958) Chemical releasers of necrophoric be- havior in ants, *Psyche,* 65(4), 108–114.

Wilson, S., and Moore, C. (2015) S1 somatotopic maps, *Scholarpedia,* 10(4), 8574.

Wiltschko, R., and Wiltschko, W. (2013) The magnetite-based receptors in the beak of birds and their role in avian navigation, *Journal of Comparative Physiology A,* 199(2), 89–98.

Wiltschko, R., and Wiltschko, W. (2019) Magnetoreception in birds, *Journal of the Royal Society Interface,* 16(158), 20190295.

Wiltschko, W. (1968) Über den Einfluß statischer Magnetfelder auf die Zugorientierung der Rotkehlchen (*Erithacus rubecula*), *Zeitschrift für Tierpsychologie,* 25(5), 537–558.

Wiltschko, W., et al. (2002) Lateralization of magnetic compass orientation in a migratory bird, *Nature,* 419(6906), 467–470.

Wiltschko, W., and Merkel, F. W. (1965) Orientierung zugunruhiger Rotkehlchen im statischen Magnetfeld, *Verhandlungen der Deutschen Zoologischen Gesellschaft in Jena,* 59, 362– 367.

Windsor, D. A. (1998) Controversies in parasitology: Most of the species on Earth are parasites, *International Journal for Parasitology,* 28(12), 1939–1941.

Winklhofer, M., and Mouritsen, H. (2016) A room-temperature ferrimagnet made of metallo- proteins?, bioRxiv, 094607.

Wisby, W. J., and Hasler, A. D. (1954) Effect of olfactory occlusion on migrating silver salmon (*O. kisutch*), *Journal of the Fisheries Research Board of Canada,* 11(4), 472–478.

Witherington, B., and Martin, R. E. (2003) Understanding, assessing, and resolving lightpollution problems on sea turtle nesting beaches, Florida Marine Research Institute Tech- nical Report TR-2.

Witte, F., et al. (2013) Cichlid species diversity in naturally and anthropogenically turbid habi- tats of Lake Victoria, East Africa, *Aquatic Sciences,* 75(2), 169–183.

Woith, H., et al. (2018) Review: Can animals predict earthquakes?, *Bulletin of the Seismological Society of America,* 108(3A), 1031–1045.

Wolff, G. H., and Riffell, J. A. (2018) Olfaction, experience and neural mechanisms underlying mosquito host preference, *Journal of Experimental Biology,* 221(4), jeb157131.

Wu, C. H. (1984) Electric fish and the discovery of animal electricity, *American Scientist,* 72(6), 598–607.

Wu, L.-Q., and Dickman, J. D. (2012) Neural correlates of a magnetic sense, *Science,* 336(6084), 1054–1057.

Wueringer, B. E. (2012) Electroreception in elasmobranchs: Sawfish as a case study, *Brain, Be- havior and Evolution,* 80(2), 97–107.

Wueringer, B. E., Squire, L., et al. (2012a) Electric field detection in sawfish and shovelnose rays, *PLOS One,* 7(7), e41605.

Wueringer, B. E., Squire, L., et al. (2012b) The function of the sawfish's saw, *Current Biology,* 22(5), R150–R151.

Wurtsbaugh, W. A., and Neverman, D. (1988) Post-feeding thermotaxis and daily vertical mi- gration in a larval fish, *Nature,* 333(6176), 846–848.

Wyatt, T. (2015a) How animals communicate via pheromones, *American Scientist,* 103(2), 114.

Wyatt, T. D. (2015b) The search for human pheromones: The lost decades and the necessity of returning to first principles, *Proceedings of the Royal Society B: Biological Sciences,* 282(1804), 20142994.

Wynn, J., et al. (2020) Natal imprinting to the Earth's magnetic field in a pelagic seabird, *Cur- rent Biology,* 30(14), 2869–2873.e2.

Yadav, C. (2017) Invitation by vibration: Recruitment to feeding shelters in social caterpillars, *Behavioral Ecology and Sociobiology,* 71(3), 51.

Yager, D. D., and Hoy, R. R. (1986) The cyclopean ear: A new sense for the praying mantis, *Science,* 231(4739), 727–729.

Yanagawa, A., Guigue, A. M. A., and Marion-Poll, F. (2014) Hygienic grooming is induced by contact chemicals in *Drosophila melanogaster, Frontiers in Behavioral Neuroscience,* 8, 254.

Yarmolinsky, D. A., Zuker, C. S., and Ryba, N. J. P. (2009) Common sense about taste: From mammals to insects, *Cell,* 139(2), 234–244.

Yeates, L. C., Williams, T. M., and Fink, T. L. (2007) Diving and foraging energetics of the smallest marine mammal, the sea otter (*Enhydra lutris*), *Journal of Experimental Biology,* 210(11), 1960–1970.

Yong, E. (2020) America is trapped in a pandemic spiral, *The Atlantic.* Available at: www.the atlantic.com/health/archive/2020/09/pandemic-intuition-nightmare-spiral-winter/616204/. Yoshizawa, M., et al. (2014) The sensitivity of lateral line receptors and their role in the behav- ior of Mexican blind cavefish (*Astyanax mexicanus*), *Journal of Experimental Biology,* 217(6), 886–895.

Yovel, Y., et al. (2009) The voice of bats: How greater mouse-eared bats recognize individuals based on their echolocation calls, *PLOS Computational Biology,* 5(6), e1000400.

Zagaeski, M., and Moss, C. F. (1994) Target surface texture discrimination by the echolocating bat, *Eptesicus fuscus, Journal of the Acoustical Society of America,* 95(5), 2881–2882.

Zapka, M., et al. (2009) Visual but not trigeminal mediation of magnetic compass information in a migratory bird, *Nature,* 461(7268), 1274–1277.

Zelenitsky, D. K., Therrien, F., and Kobayashi, Y. (2009) Olfactory acuity in theropods: Palaeobiological and evolutionary implications, *Proceedings of the Royal Society B: Biological Sciences,* 276(1657), 667–673.

Zimmer, C. (2012) Monet's ultraviolet eye, *Download the Universe.* Available at: www.downloadtheuniverse.com/dtu/2012/04/monets-ultraviolet-eye.html.

Zimmerman, A., Bai, L., and Ginty, D. D. (2014) The gentle touch receptors of mammalian skin, *Science,* 346(6212), 950–954.

Zimmermann, M. J. Y., et al. (2018) Zebrafish differentially process color across visual space to match natural scenes, *Current Biology,* 28(13), 2018–2032.e5.

Zions, M., et al. (2020) Nest carbon dioxide masks GABA-dependent seizure susceptibility in the naked mole-rat, *Current Biology,* 30(11), 2068–2077.e4.

Zippelius, H.-M. (1974) Ultraschall-Laute nestjunger Mäuse, *Behaviour,* 49(3–4), 197–204.

Zuk, M., Rotenberry, J. T., and Tinghitella, R. M. (2006) Silent night: Adaptive disappear- ance of a sexual signal in a parasitized population of field crickets, *Biology Letters,* 2(4), 521–524.

Zullo, L., et al. (2009) Nonsomatotopic organization of the higher motor centers in octopus, *Current Biology,* 19(19), 1632–1636.

Zupanc, G. K. H., and Bullock, T. H. (2005) From electrogenesis to electroreception: An overview, in Bullock, T. H., et al. (eds), *Electroreception,* 5–46. New York: Springer.